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## THE TRIAL OF THE MARCONI TELEGRAPH AT SPEZIA.

TELEGRAPHY without wires is still the all-absorbing topic of the day, and, therefore, although we have already published considerable about Marconi and his work, we feel sure that our readers will be interested in the accompanying engravings, one of which is a portrait of Marconi, while the other shows him as he appeared when receiving messages during his experiments at Spezia, the receiving apparatus being on a moving boat. He was assisted at this time by the electricians Civita and Pasqualini, whose portraits we also have in this engraving.

These experiments, which lasted three days, July 11, 12 and 13, were conducted on a large scale by order of the naval department, so that the full scope of the invention might be understood. On the 11th the experiments were made between the San Bartolomeo Arsenal and the offices of the department, a distance of about two and one-half miles; on the 12th the experiments were public; and on the 13th messages were sent from one moving vessel to another, care being taken to have obstacles between the vessels, as it was desired to prove beyond a doubt that no obstructions of any kind would interrupt communication. L'Illustrazione Italiana publishes the following report of the trials made on the 12th:

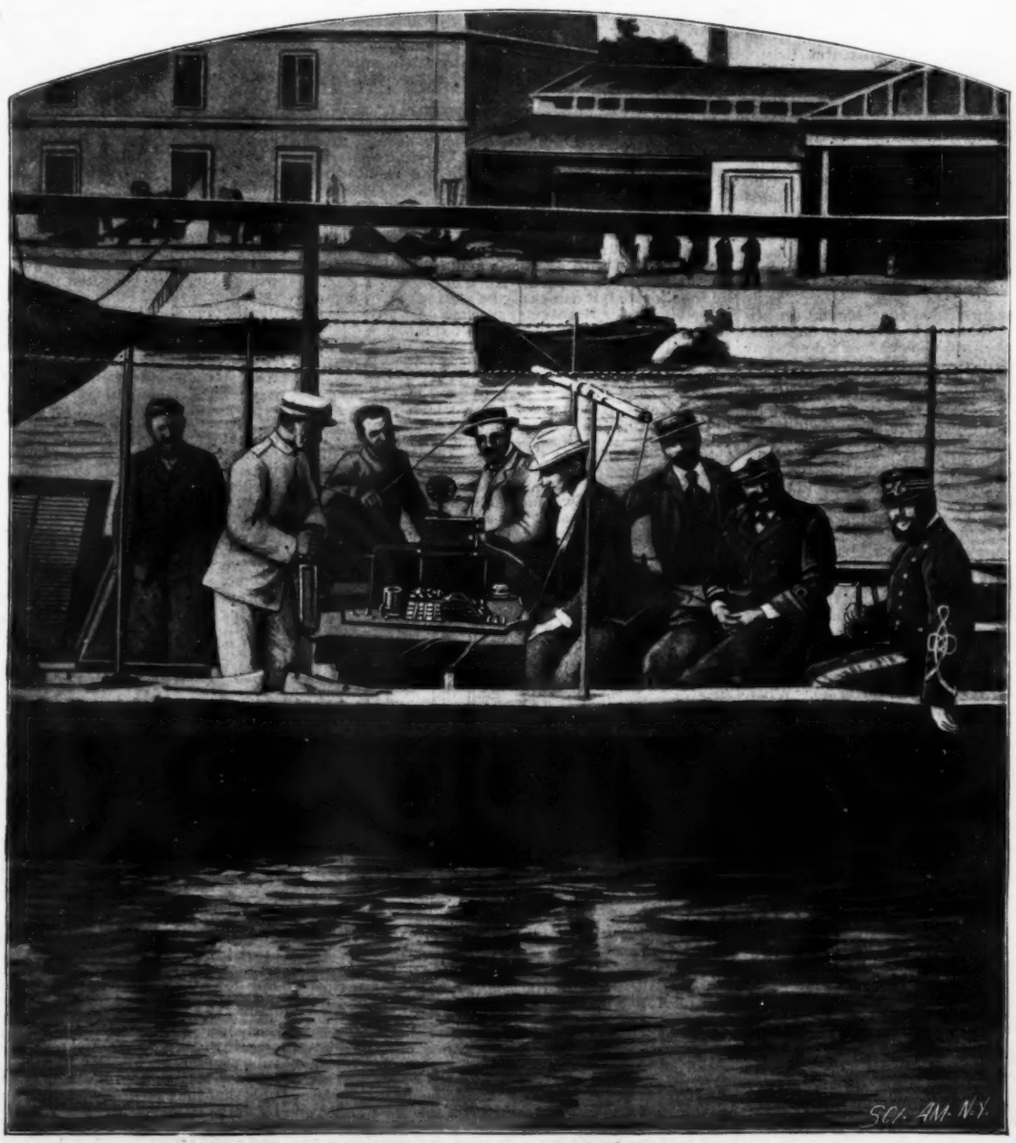
"The experiments took place at the arsenal at Spezia; Marconi and the electrician Civita remaining at the receiver, which was placed near the entrance of the headquarters, while Prof. Pasqualini, of the department of electricity and war supplies, stood by the transmitter, outside of the directors' room at the arsenal. Before beginning the experiments Civita explained the apparatus. The results were splendid, as they always are. Various phrases were transmitted, such as 'Evviva Marconi.' 'Evviva Bologna.' (The latter is the native city of the young inventor.) Several officers of the navy, the engineer corps and the artillery addressed questions to Marconi, who answered them all, although tired from the excitement and work of several consecutive days. Admiral Grillo presided, assisted by the commander of the Spanish vessel Cristobal Colon."

SIGNOR MARCONI.

In speaking of his own work, Marconi says:

"The greatest distance to which we have been able to transmit messages by telegraph without wires is twelve miles. But that by no means is the limit of the instrument; it simply signifies that existing appliances are not perfect. At Spezia I sent messages without wires from the San Bartolomeo arsenal to the war ship San Martino, twelve miles out in the harbor, without difficulty and with absolute accuracy. It was done before the royal commission. Official experiments will be renewed when I return to Italy in September. I have successfully experimented also at the Italian Ministry of Marine and at the Quirinal before the King and Queen. I made the discovery almost by accident. I had been studying electrical phenomena three years, when two years ago I found that by putting Hertz's radiator to the earth, connecting it with a wire extended vertically in the air and repeating the process with the modified Bramley receiver, a current could be transmitted about one hundred yards without connecting the wires. Then I found that, without increasing the battery power but by simply increasing the height of the vertical wire, the influence of the instrument extended over a distance increasing in geometrical ratio to the increased height of the wire.

"The wire must extend into the air. A coiled wire helps only as the coil is high, not according to the length of wire in the coil. A wire inclined instead of vertical has power equal only to that developed by a vertical wire as much shorter as the distance taken up by the inclination. A wire carried to the top of the high mast of a ship ought to enable the captain to telegraph a considerable distance, figuring that 100 feet in height of the wire means twelve miles in distance of communication. By the same process magazines could be exploded in time of war from a great distance, and signals could be sent so that the enemy could not possibly interrupt communication. It has been said that this would work both ways, that a current radiates in all directions from the sending instrument and, therefore, that a message would go to the enemy's camp as well as to a friend's. But this can be easily prevented, as I have proved, by means of electrical reflectors, which would arrest the progress of a message in all directions but one. I am not certain that I shall ever be able to send messages across the Atlantic, but I can see no reason why I should not do so, if I can increase the height of a vertical wire enough. I am just as much in doubt as you are as to the reason for this strange influence of a vertical wire over the strength of a current in this new development of that most mysterious of all agents, electricity. It will not cost more than half as much to install a telegraph system on my plan as it would on the old system. The instruments are slightly more expensive, but I imagine a decrease in cost would be brought about by the absence of miles of wire and poles."




EXPERIMENTS WITH THE MARCONI TELEGRAPH—THE RECEIVING APPARATUS IN A BOAT AT SPEZIA.

W. H. Preece, electrician to the British post office, made the following report of the experiments in England last year by Marconi:

Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which for sensitiveness and delicacy exceeds all known electrical apparatus. The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used. His transmitter is Professor Righi's form

of Hertz's radiator. Two spheres of solid brass four inches diameter are fixed in an oiltight case of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. Two small spheres are fixed close to the large spheres and connected each to one end of the secondary circuit of the induction coil, the primary circuit of which is excited by a battery, thrown in and out of circuit by the Morse key. Now, whenever the key is depressed sparks pass, and since the system contains capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of frequency of oscillation is probably about 250,000,000 per second. The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A six inch spark coil has sufficed up to four miles, but for greater distances we have used a more powerful coil—one emitting sparks twenty inches long. It may also be pointed out that this distance increases with the diameter of the spheres, and it is nearly doubled by making the sphere solid instead of hollow.

"Marconi's relay consists of a small glass tube four centimeters long, into which two silver pole pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of four millimeters and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are polarized, and order is installed. They are marshaled in serried ranks, they are subject to pressure—in fact, they "cohere"—electrical contact ensues and a current passes. The electrical resistance of Marconi's relay—that is, the resistance of the thin disk of loose powder—is practically infinite when it is in its normal or disordered condition. It is then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It, therefore, becomes a conductor. Marconi "decoheres" by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings, which, by their size, tune the receiver to the transmitter. Choking coils prevent the energy escaping. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited, and signals made.

"In open, clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed, and tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles. Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture. It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. Weather seems to have no influence; rain, fogs, snow, and wind avail nothing." For our engraving we are indebted to L'Illustrazione Italiana, and for our portrait to the Illustrirte Zeitung.

## SECTORLESS WIMSHURST MACHINES.*

By S. M. KEENAN.

THERE exists a prevailing idea that sectors are absolutely necessary on a Wimshurst influence machine, while in point of fact they are somewhat of a detriment when a large output and long sparks are required. The only objection to sectorless machines is their inability to self-excite. This is a minor consideration in a large machine, as a charge is readily imparted and can be retained, often for hours, while the machine is idle. A rod of vulcanite, gutta percha, glass, wax, etc., excited by any of the well-known methods, and held opposite the neutralizer, easily imparts a charge. Any particular sign can be given to either side. If the machine be incased and it is not desirable to open the case, a small self-exciting machine may be placed in the case or under it and proper connections made with the prime conductors. These connections, likewise the attachments for imparting motion to the exciter, may be controlled from the outside. Similar arrangements are made use of by Waite & Bartlett, by Van Houten and by Ten Broeck to excite their large Holtz machines.

The only requirements necessary to change a sectored to a sectorless machine is to attach several brushes or points to each section of the neutralizer and discard the sectors. It makes little difference whether brushes or points are used, the results are about the same. When brushes are used they gradually wear off and require renewing, whereas points are free from this objection, as they do not touch the glass. Points, however, require very careful adjustment, particularly in large machines with multiple plates, as they are liable to scratch the shellac off the plates or perhaps fracture them. The more of the radial surface brushed or that passes in front of the points, the greater the output. There is, however, a limit, as a spark is liable to jump from one collector to the other by way of the neutralizer if the end of the latter is very near the center. A little experimenting will soon give the proper positions. To adapt the machine for the production of long, thin sparks, or short, thick ones, it is well to provide adjustable neutralizers and collectors.

The first published notice of a sectorless Wimshurst appeared in La Nature April 14, 1894. The machine therein described is the embodiment of an idea suggested by M. Pellissier in 1891 in the Journal de Physique. This machine, constructed by Mr. Bonetti, appears to have been preceded by one made by A. J. Picolet. The essential features of both are the same, the only difference is that Mr. Bonetti used several brushes on the neutralizer, while Mr. Picolet employed points. Mr. Bonetti's machine measured by a Lane electrometer, according to the authoritative statement of Mr. D'Arsonval, who carefully tested it, "gives a discharge three times greater than a machine of similar dimensions provided with sectors." Illustrations and full descriptions of Picolet's and Bonetti's machines may be found in the SCIENTIFIC AMERICAN, May 26, 1894.

The writer was constructing a two-plate, 18 in. machine, when the description of Bonetti's machine appeared, and decided to try it before the sectors were placed on the disks. A rubber comb passed through the hair once or twice excited the machine, but the discharge was insignificant, due to the small surface brushed, there being employed but the four brushes as used on the sectored machine. When the room was darkened the glow appeared only in the region of these brushes. A wire was then passed diametrically across the plates on each side and fastened to the ends of the neutralizing rods. Tinsel brushes were attached 1 in. apart on

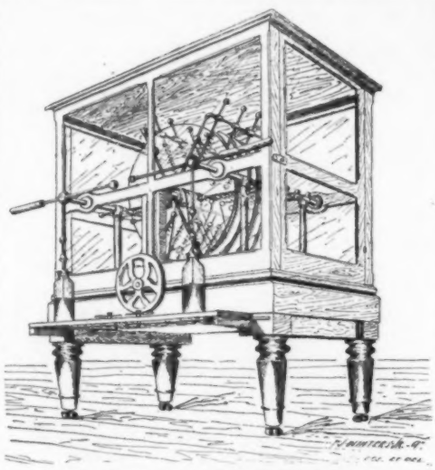


FIG. 1.—SECTORLESS WIMSHURST MACHINE.

the wires and pressed gently against the glass. By this arrangement almost the entire surface of the disks was brushed. Upon exciting the machine the effect was magnificent. Powerful sparks 8 in. long passed between the knobs.

An adjustable neutralizer has been substituted for the temporary wires. This machine never fails to work when a Voss or regular Wimshurst will excite. Some days during the summer when the atmosphere is very humid it will not work, nor will any other, unless it be incased and drying material placed in the case. Under similar conditions, with an exciter in the case, a sectorless machine will work during any weather. There are two sets of plates for this machine, one with and one without sectors. But a few moments are required to change it from one to the other. Careful comparisons have been frequently made, with the result always greatly in favor of the latter.

A 40 in., two disk, sectorless machine was constructed last year for Roentgen ray work, but it is not suitable for exciting Crookes tubes, owing to the small output in current. Two things are essential for exciting Crookes tubes with a static machine—multiple plates or very high rotary speed. As 40 in. glass disks cannot be thus rotated, it can easily be seen why this machine is unsuitable for Roentgen experiments.

The writer has lately constructed a twelve-plate, 32 in. diameter, sectorless machine, which answers so perfectly every purpose of experiment and electro-therapeutics that a brief description may prove of some interest. Fig. 1 gives a general idea of the machine, with the exception of the exciter, which is not shown in the sketch. The driving pulleys and bosses are the same as on an ordinary machine, with the exception that the steel shaft for the pulleys turns in roller bearings. The rest of the machine is entirely different from Wimshurst's. The base frame is made of 3½×5½ in., kiln-dried yellow pine, and mounted on suitably turned legs. This base gives a very firm foundation to the machine and prevents the glass case from shaking

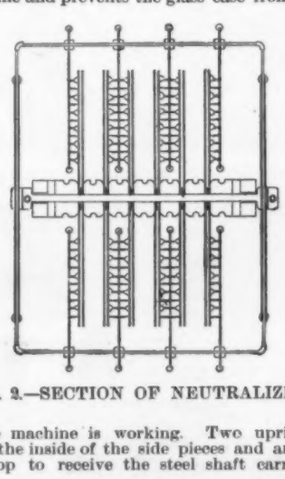


FIG. 2.—SECTION OF NEUTRALIZER.

when the machine is working. Two uprights are bolted to the inside of the side pieces and are slotted at the top to receive the steel shaft carrying the plates.

Fig. 2 shows a section of the adjustable neutralizer. This consists of a rectangular frame that passes entirely around the plates and is mounted on the disk shaft by double knobs. These knobs are tapped for a piece of tubing the same size as the bushing of the bosses and serve as bearings for the shaft. Taper-bored ball nuts are fitted on each end of the cross arms and hold the transverse rods near or remote from the edges of the plates. The radial rods that carry the brushes are mounted on the transverse rods by cross-bored knobs that slide on the transverse rods. By means of set screws these knobs may be set in any position; likewise the radial rods. By this combination, which was made purposely for wide adjustments in experimenting, the neutralizers may be placed at any angle, the radial rods may be all raised or lowered together or separately, and, in fact, any adjustment desired may be made in a moment. This rather complex neutralizer adds considerably to the expense of the machine, but is very desirable when careful investigations are required. The radial rods carry alternate brushes and points set 1½ in. apart, and brush any portion or all of the plate as desired. The brushes and points are interchangeable, and hence brushes alone or points alone may be used.

The prime conductors (see sections, Figs. 3 and 4) are supported on vulcanite posts and the discharge rods fitted into either ends of these conductors, affording the use of the dischargers from either side of the machine. The collecting combs are adjustable up, down and sideways on the prime conductors. As window glass plates of large size are more or less "dished," this arrangement of the collecting combs is desirable owing to the fine adjustment it affords.

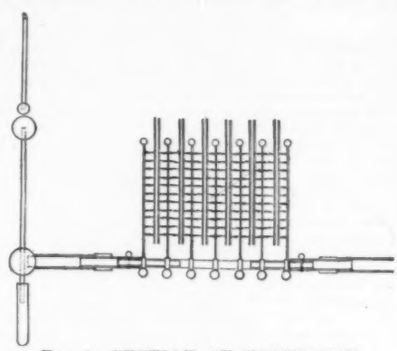


FIG. 3.—SECTION OF COLLECTOR.

The Leyden jars may be placed inside the case or outside on a movable shelf. The external coatings of the jars are connected underneath the shelf by a sliding switch that protrudes therefrom close to the hand of the operator, enabling him to produce the spark or brush at pleasure. Two binding posts are connected to either portion of the switch for administering an induced current or for attachment to the primary of a D'Arsonval or similar high frequency transformer. These binding posts carry sliding dischargers for the regulation of the induced spark. By these the induced current may be made to assume a continuous or an interrupted oscillation. By them the volume of the direct discharge may likewise be controlled to a nicety. This has been found very serviceable in Roentgen ray experiments in conjunction with a regulated spark gap in the main circuit. When a Crookes tube is placed in the direct circuit—the best method by far—and the induced circuit closed, fitful sparks generally pass across the gap, rendering the illumination of the tube very bright but inconstant. If the induced circuit be opened beyond sparking distance, the discharge at the gap will be constant, but often too weak for powerful excitation of a tube of high vacuum. But, if the induced dischargers be separated gradually, a point will soon be found at which the tube becomes brightly fluorescent and very constant, giving rise to abundance of Roentgen rays which render quite distinct in the fluoroscope the shadows of the deeply seated bones.

The case is made in two sections and may be removed at pleasure, as the operating parts of the machine are constructed independent of the case. To remove the case, the key bolts for holding the dischargers to the prime conductors are removed and the dischargers taken off, the hooks at the top of the case opened and each half section lifted off the base separately. This is particularly advantageous for the purpose of replacing broken disks.

This machine has been in operation for three months in the Wayne County (Mich.) hospital, and has given the very best of satisfaction to the physicians in charge. It embodies all the latest features for electro-therapeutic treatment and has proved a valuable remedial agent in many diseases. With suitable Leyden jars it produces powerful sparks 15 in. long and absolutely deafening. When a patient is placed on the insulated stool, connected with one of the dischargers, and the outside coating of the jars disconnected, powerful brush discharges several inches long and entirely painless may be drawn from any part of his body. For Roentgen ray work it is excellent. Its enormous output, suitably regulated, renders the largest tubes intensely active with perfect ease. Nor does it dangerously heat up a tube—the great fault of induction coils; after using it constantly for two hours or more the tube remains comparatively cool.

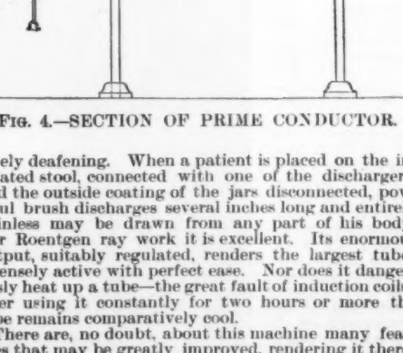


FIG. 4.—SECTION OF PRIME CONDUCTOR.

There are, no doubt, about this machine many features that may be greatly improved, rendering it thereby much more efficient, for it is exceedingly difficult to construct anything along lines of a radical departure and avoid errors.

* From the American Electrician.

## DESCRIPTION OF A CLOSING TOW NET, FOR SUBMARINE USE AT ALL DEPTHS.*

By C. H. TOWNSEND, Assistant, U. S. Fish Commission.

RECENT experiments with closing tow nets in submarine explorations have yielded so much accurate information concerning the vertical range of pelagic life, that the construction of the Tanner intermediate tow net in 1891† may be said to have inaugurated a new era in the study of the pelagic fauna, characterized by exact knowledge of the depth of the forms collected.

The vertical distribution of the pelagic life gathered with the open tow nets of the Challenger expedition has necessarily been conjectural, the nets employed having been dragged open at all depths. Since then European investigators have employed several devices for closing submarine tow nets, but direct evidence as to their reliability, so far as the writer is aware, seems to be lacking.

Open tow nets of different forms have long been employed by the United States Fish Commission, while a closing collector, although of very limited capacity (the Sigsbee gravitating trap), has done service on the Coast Survey steamer Blake; but it was not until 1891 that a closing tow net of large size was brought into use. The Tanner tow net, closing tightly at any depth desired, has proved its efficiency during recent explorations conducted by the Fish Commission and by Mr. Alexander Agassiz, but its large size and somewhat complicated construction have prevented its use except by steam power from large vessels.

While towing a light surface net behind one of the small boats of the Albatross in an Alaskan harbor in the summer of 1894, the idea of a very simple closing net presented itself, which was at once experimented upon and gave satisfactory results. I at first used it in moderate depths only, but subsequently, having made one of heavier form than at first employed, the principle was found applicable to deep sea work as well as near the surface.

This form of towing net is, on account of its lightness and simplicity, convenient for use by hand from all kinds of small sailing craft and open boats. It can be rolled into a small package with all its attachments and carried readily in one hand. With a light tow line passed through a pulley slung from one of the boat davits of the Fish Commission steamer Albatross, it has been hauled in from depths of 20 and 30 fathoms by one man with very little exertion, and has not failed to work in a single instance.

In the summer of 1895 this net, constructed in larger and heavier form, with a net ring 3 feet in diameter, was used successfully on board the Albatross during fishery investigations in Bering Sea, at depths varying from 20 to 200 fathoms.

Following is a description of a closing net of medium size constructed for use on the Fish Commission schooner Grampus (Pl. 1, Figs. 1 and 2). It consists of a tow net with a folding ring suspended by rope slings from a tripping arm attached to the tow line, and is operated at will by a messenger. The ring to which the net is attached is hinged to fold, for the purpose of closing the net, and is supported by two sets of slings of nearly equal length, one set attached near the hinges, supporting the net in an open position, the other attached at right angles to the hinges, supporting it in a closed position.

Closing is effected by means of a tripping arm, from which the slings are suspended, and which, being tripped by a messenger, shifts the weight from the opening to the closing slings, with the result of closing the net. The tow line is attached to the lower end of the tripping arm, the upper end of which is hooked to a ring on the tow line. The opening slings are secured near the upper end of the arm, the closing slings to the lower end. A light messenger (Pl. 1, Fig. 3) sliding down the tow line detaches the messenger ring from the upper hook of the tripping arm, shifting the weight from the opening to the closing slings. A spring catch in the upper hook of the tripping arm keeps the messenger ring from slipping out of place until struck by the messenger, while a heavy ring-shaped weight, released by the tripping of the arm, slips from the lower hook of the arm down the closing slings and keeps the jaws from opening after they have been closed by the messenger. The accompanying figures, showing the net in both open and closed positions, illustrate its workings clearly.

The tripping arm is merely a piece of half-inch brass, ordinarily about 2 feet in length and of the shape shown in the cut. The ring is 2 feet in diameter, made of ¾ by ¼ inch brass, and is essentially the same as that employed by Agassiz for use with his modified Chun-Petersen machine.* The messenger is a 2 pound bronze casting, in two parts, to lash around the tow line. A small lead sinker is lashed to the bottom of the net, of sufficient weight to carry it down clear of the ring, as it is, of course, lowered vertically and the vessel from which it is operated brought to a full stop. The net is light and of small mesh, preferably half inch. It is lined with bobbinet or mosquito netting, with a delicate inner lining of silk bolting cloth, the last being the real collector, to which the outer nets act as supports.

In this combination of three nets all are of full width to the bottom, where they are closed by a lashing, the inner nets being secured rather slack, in order to avoid strain upon them in towing. As used on board the Albatross, by steam power at all depths, the net and its appliances have been constructed somewhat heavier and stronger. Additional weight is secured by passing the tripping arm through a 60 pound shot, of the ordinary pattern used for sounding, the shot being secured by a bolt to prevent its slipping when the arm is capsized. (See Pl. 1, Fig. 4.)

A deep sea tow net, closed, with the folded jaws protecting its mouth, offers little resistance to the water, and can be heaved in rapidly without the danger of being torn away from an open and widespread net ring, while the friction upon the contained organisms is reduced to the minimum.

The time gained in deep sea work, with a folding ring net which will permit of the steam winch reeling in at full speed, and the small stowage space required on shipboard for a net of this pattern, are matters of considerable importance. The readiness with which this net can be carried on deck by one man and attached to the wire dredge rope without complicated adjusting is perhaps the most important point of all in its favor, while its cost is less than that of any intermediate net hitherto employed.

This device has also been constructed in very light form, with a net ring 18 inches in diameter, for use in lakes or at very moderate depths, the heavier outside net being done away with, leaving merely the mosquito netting with its lining of silk bolting cloth.

In this form it will be useful in gathering the minute life, crustacea, etc., of the Great Lakes, a knowledge of which is essential in its bearing upon the food of young whitefish and other important fishes now being propagated artificially.

The folding ring tow net is also available for use as an ordinary surface tow net, without the employment of the messenger and the lead sinker.

The collections made by the Albatross during the past summer with the intermediate net were from depths of 20 to 200 fathoms, the net being lowered in one instance to 575 fathoms, when it accidentally touched bottom. The forms obtained consisted principally of minute crustacea, medusæ, annelids, and fishes, which have not yet been studied; but the ordinary surface tow net having been used at the same stations as the intermediate net, the contents of the two nets were usually found to differ somewhat in character and quantity. As a rule, the surface net contained a slightly greater quantity of material than the intermediate net, but at some stations the reverse was the case, while the intermediate net sometimes brought up forms not taken at all in the surface net. The towings, 18 in all, were made along the border of the submarine bank

* From a pamphlet issued by the U. S. Fish Commission.

† Tanner, Rept. U. S. Fish Com. 1889-91, pp. 250-260. Bull. U. S. Fish Com., 1894, pp. 143-151.

* Agassiz, Bull. Mus. Comp. Zool., 1892-93, vol. xxiii, p. 45, etc.

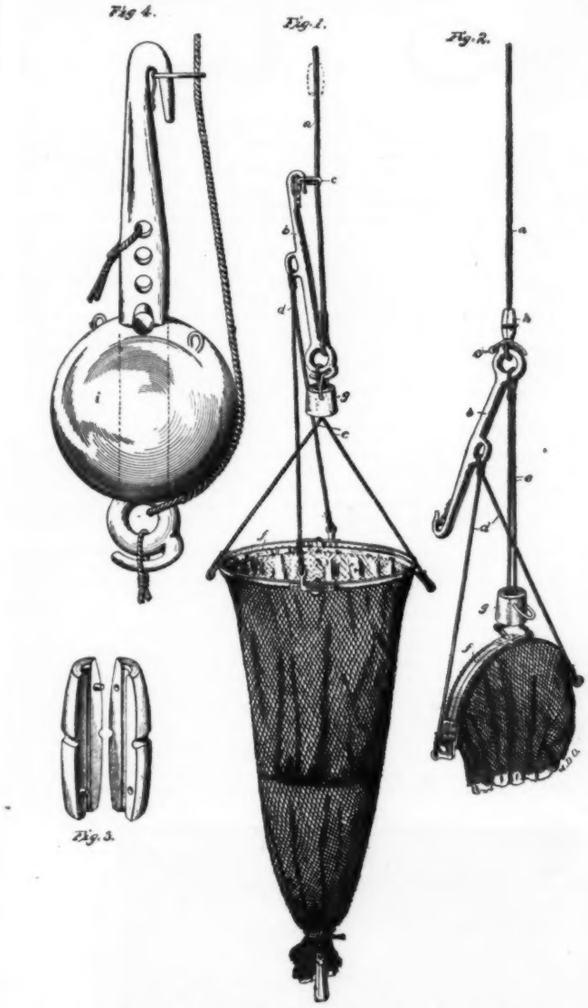



FIG. 1.—Showing net in position for lowering and towing: a, tow line; b, tripping arm; c, tripping ring; d, opening slings; e, closing slings; f, folding net ring; g, closing weight; h, closing messenger (see also Fig. 3). FIG. 2.—Showing net closed for heaving in. FIG. 3.—Closing messenger. FIG. 4.—Showing heavy tripping arm used on steamer Albatross, with 60 pound sounding shot attached as sinker for proper strain on wire tow line in deep sea work: i, common sounding shot—60 pounds.

PLATE 1.—CLOSING TOW NET.

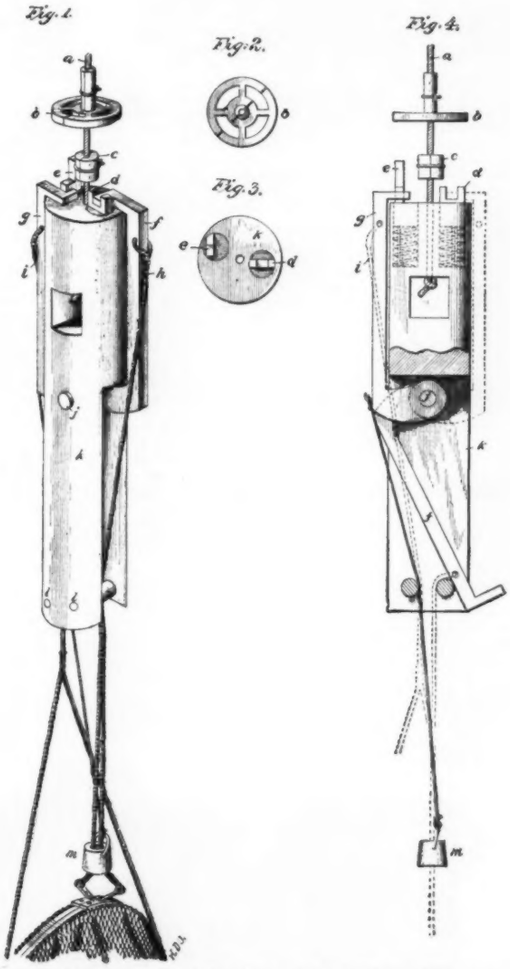



FIG. 1.—Showing net in position for lowering: a, wire tow line; b, second messenger—to close; c, first messenger—to open; d, plunger securing right arm; e, plunger securing left arm; f, right arm; g, left arm; h, closing slings; i, opening slings; j, bolt securing tripping arms; k, body of machine (2 ft. 3 in. long); l, bolts holding net lines on center of gravity; m, closing weight. FIG. 2.—End view of second messenger. FIG. 3.—End of machine, showing position of plungers. FIG. 4.—Showing right arm tripped, springs to plungers, and knot securing tow line.

PLATE 2.—CLOSING TOW NET.

south of the Pribilof Islands during the month of August, from lat. 54° to 56° N. and long. 167° to 172° W. Soundings were from 75 fathoms, on the bank, to 1,901 fathoms beyond it. There can be no doubt that there is an abundance of pelagic life at 200 fathoms in this part of Bering Sea.

After some experience with the single tripping arm described, I designed a machine for opening as well as closing the jaws of the tow net, which worked satisfactorily (Pl. 2). It is a combination of two tripping arms, for operating which two messengers are employed on the same tow line, the second striking a separate detacher from the first. A rough experimental machine, constructed on board the Albatross, was used successfully in port, but did not have strength to withstand the strain of towing at sea. Experiments indicate, however, that a properly constructed machine of the same pattern would accomplish the desired result. Its use in place of the single tripping arm permits of the folding ring tow net being lowered in a closed position, the closing slings being attached to the right arm, the opening slings to the left. The arms are bolted to a bar of brass about 2 feet long, suspended from the tow line, and in position for use are hooked upright to detachers released by messengers. The first messenger tripping the right arm, the jaws of the net fall apart for towing. The second messenger, in turn, tripping the left arm, the weight is thrown back on the slings of the right arm, closing the jaws. A ring-shaped weight around the right slings, and suspended from a hook on the left arm, holds the jaws together for lowering. It is released upon the tripping of the left arm, and slips again to its position upon the right slings, holding the jaws together for heaving in.

The net being closed tightly in going down, it is not necessary to stop the vessel and lower it vertically.

## UNDERGROUND PHOTOGRAPHY.*

THE value of photographs in a mining report is evident to everyone, and there are few engineers who have not wished at various times that they could illustrate their papers by means of the camera. I will endeavor to show how, with the simple appliances that can easily be carried into a rough country, photographs can be secured which will much more than repay the slight cost and trouble in taking.

The camera is the most important part of the outfit, and this should be the best obtainable, and in most cases where portability is an object, carrying not larger than a 5 × 7 in. plate. It should be folding, self-containing and, where necessary, focusing by a scale in front, without the aid of the ground glass. The camera should have double swing-backs and sliding front. The tripod, as in surveying, should be adjustable to different heights, and is much steadier by having its legs in only two sections. One should have two lenses, wide angle and rectilinear, for underground and surface work, and these should be able to cover a larger plate than the camera carries, so that the image is sharp when both sliding front and swing-backs are used. The best lenses are none too good, as great rapidity is almost always an advantage. The most useful shutter is probably the automatic Bausch & Lomb, with iris diaphragm. I use a 4 × 5 in. folding Kodak, sliding front and double swing-back, Bausch & Lomb lens and shutter. The Poco, Premo, Wizard and some other cameras, when fitted with wide angle lenses, are admirably adapted for underground work, and are very portable.

The plates used should be the quickest possible to obtain. Seeds 27 and Carbutts, also the quick plates of some other makers, work nicely, but little or nothing can be done with a slow plate. Films rarely give complete satisfaction, but where great portability is required cut films seem to work fairly well. The lamp is very important. I have found the "Perfection" lamp (Fig. 2), while not perfection, perhaps the nearest to it of any lamp. The "Perfection" is a magazine lamp, and will serve for from 5 to 15 exposures without refilling. An admirable lamp is made by taking a clay pipe, wiring on to it a lamp wick. The magnesium powder is put in the bowl and the wick, previously soaked in alcohol, is lighted. The magnesium is blown up through the flame by means of a rubber tube or a bulb such as is used with the shutter of the camera. This outfit, costing about 1½ cents, will make as good a picture as the best lamp in the market, but has to be filled each time it is used. This, however, is perhaps an advantage, as it enables the photographer to control the intensity of his flash by the amount of magnesium used, which has to be guessed at with a magazine lamp. Fig. 1 shows the contrivance ready for use.

Blitz-pulver may be used without a lamp, and simply ignited on a rock or shovel. It is easier to regulate the amount of light and much quicker, but it is harder to direct the light and makes more smoke. Magnesium powder with a lamp is, in my opinion, far nicer, less expensive, and in most cases better than blitz-pulver. A box to contain the instruments, plate holders, etc., together with a flask of alcohol for the lamp, is useful. At all events, they should be carried in such a way as to be easily found in obscure light.

In taking the picture it is not necessary to focus very carefully, as the wide angle lens is very nearly universal focus. The best way is to focus with the ground glass on some object about 20 feet away, make some kind of a mark and use this where the light is obscure underground. The camera must be leveled carefully, as the wide angle distorts somewhat, even under the best conditions. This operation is quickened by having a level or a pair of levels on the swing-back. If the swing-back is level, the picture will not be distorted, but the plates must be perpendicular, no matter where the lens is pointing. A ball and socket joint aids in leveling, but makes the camera less steady. By moving candles or lights in front of the camera one can tell exactly how much ground the lens covers and just what the photograph will include. There is rarely enough light to see the image distinctly on the ground glass. Everything being ready, the slide is withdrawn from the plate holder, the shutter opened, unless it was left open in the beginning. The lamp is set going from behind or to one side of the camera a few inches back of the lens. The flash must never get in front of the lens, though candles or lights may be left burning if they are not moved. The exposure lasts according to the size of the workings, and the length of the flash can only be learned by experience. Perhaps three thimblefuls of pure magnesium, or about twice the quantity of blitz-pulver, would light an ordinary sized drift or stope. If the photographer stands behind the camera and causes the lamp to move in an arc from one side over the top to the other, blowing slowly all the while, to throw the light in all directions, the best results can be obtained. A reflector is sometimes useful.

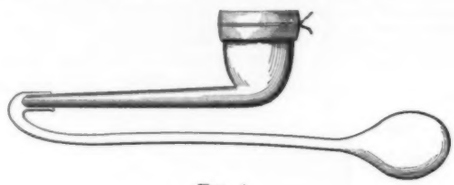


FIG. 1.

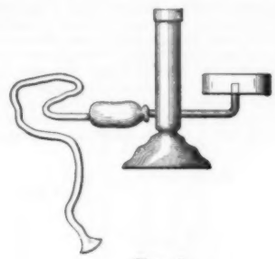


FIG. 2.

Care should be taken not to let the smoke get in front of the camera, as this fogs the picture. This is very difficult in taking low drifts and upraises. In such places it is usually necessary to use blitz-pulver where the plate is exposed and the flash finished before the smoke really gets started. In all cases it is well to study the direction of air currents, both while making the flash and also when a good exposure is desired. I have found it almost impossible to take a second good picture within a reasonable time, even in well ventilated mines. After flashes as well as after blasting, even when the smoke is gone, there seems to remain a practically invisible gas which throws the objects in the picture all on one plane and makes the photograph look like a bass-relief. In taking pictures of shaft houses and mills even in daylight it is often advisable to give one or more flashes to bring out more detail in obscure places. The contrasts otherwise are liable to be too great.

A few words should be added on the subject of developing and printing. Underground flashlights, having so little contrasts, need a good light in developing. They should be developed slowly, and will often be improved by intensifying later on. The author prefers negatives bordering on dense, and thinks that it is difficult if not impossible to over-develop a properly exposed or an under-exposed plate. In the boxes with the plates will be found formulas from the makers for developer, intensifying and reducing solutions, and these are usually best suited to the particular brand of plates. Eastman's eikonogen powders and Dr. Anderson's eikonogen cartridges are very useful in traveling. They are cheap, take up little room and do very good work. In developing in tents and the like, starlight or indirect moonlight does little or no harm.

The engineer rarely does his own printing, but he will be rewarded as a rule when he does. Platinum paper gives the best results, as it tones down the sharpness of the ordinary flashlight negative. It is the easiest and quickest paper to handle, though somewhat more expensive than the gelatine papers. Bromide paper, except for very thin negatives, is not as good as platinum, as it is likely to intensify the faults of the negatives. It is admirable, however, for enlargements, and most negatives taken by flashlight can be enlarged with good results.

The accompanying illustrations are reproductions of underground photographs taken in mines in the vicinity of Clear Creek and Idaho Springs in Colorado. They show what can be done with the camera in a mine.

BEGINNING OF A STOPE.

JUNCTION OF TWO VEINS.

PHOTOGRAPHS TAKEN IN THE PRUSSIAN MINE, COLORADO.

## MOISTURE IN COAL.

THE characteristics of different coals with reference to their ability to absorb moisture vary between wide limits. Anthracites are almost wanting in this property. The surfaces of the lumps of anthracite coal become wet when exposed to rain; but there is scarcely any penetration of the moisture into the structure. The semibituminous coals, of which the Cumberland and Pocahontas are examples, absorb some moisture because a considerable portion is usually in the condition of dust; but the part which consists mainly of lumps absorbs little more water into the body of the fuel than does anthracite coal. If a small pile of Cumberland coal which has been wet by the rain is left in the open air, the moisture will quickly and almost wholly disappear after one or two days' drying. The percentage of moisture which these coals contain when subjected to the ordinary exposure of transportation and storage in an unprotected pile seldom reaches as high a point as 5 per cent. The bituminous coals have different properties in this respect. Their power of absorbing moisture is much greater. Some of these coals, which have all the appearance of being practically dry, will, when tested for moisture, shrink 5 per cent. or more. The water enters the structure, and becomes in some degree hydroscopic. The surface indications fail to reveal it. These coals sometimes contain no less than 15 per cent. of moisture, and yet they appear no more moist on the surface than Cumberland coal, which holds but 5 per cent.

It is a matter of some concern how to treat the moisture in the case of wet coal used on an evaporation test. It is agreed that the basis of computation should be the weight of dry coal; but the point at issue is whether the boiler should be given credit for the evaporation of the moisture in the fuel. The subject does not have the importance with the higher grades of coal, because these seldom contain much moisture. As it happens, the coals which contain the large quantities are the ones which are often of the poorest class. With an evaporation, for example, of 5 to 1 and 15 per cent. moisture in the coal, the credit to which the boiler is entitled for evaporating this moisture is 3 per cent.; whereas, in the case of the high grade coals giving, perhaps, 10 to 1 evaporation, with 5 per cent. moisture, the percentage is only one-half of 1 per cent. It would appear, then, that the subject might in some instances be of great importance.

How this should be decided is a question depending upon the object in view. If the commercial value of the coal is the thing desired and the moisture is one of its usual characteristics, then no allowance of any kind should be made for it. The moist condition is the state in which it is purchased, and that is the condition on which the results should be based. If the efficiency of the boiler as a steam generator is desired irrespective of the coal used, it seems certain that the boiler should have the benefit of every advantage to be derived from the use of dry coal, and, under those circumstances, it should have the credit of evaporating the moisture

* Written for the Engineering and Mining Journal by James Underhill.

which the coal contains the same as though moisture was in the interior of the boiler. The boiler should in no respect be made to suffer because of the heat lost in this way.—Engineering Record, U. S. A.

## ALUMINUM IN KNITTING MACHINERY.*

By GEORGE D. RICE.

FIVE years ago the price of aluminum was $5 per pound. Now it can be purchased for 50 cents per pound. With the reduction in price has come a gradual employment of the metal in all lines of machine work.

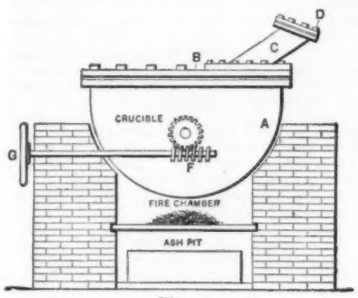



Fig. 1

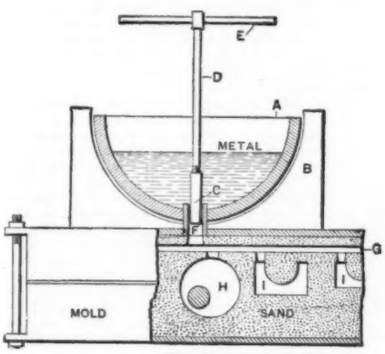



Fig. 2.

The writer has interviewed knitting machine builders who have experimented with aluminum and aluminum bronze castings in parts of knitting machinery that require great strength, and other builders who are contemplating work on this line.

As the processes of treating and casting aluminum for knitting machinery parts are quite new, the accompanying illustrated description may be useful to those knitting machine builders who wish to try the new metal. Aluminum castings can be bought at the foundries from 45 cents per pound and upward. The price for aluminum hardened with other alloying metals is a few cents higher per pound. The tensile strength of the hardened metal averages 21,000 pounds per square inch, thus making it well adapted to many small parts of the knitting machine. Tests have demonstrated that the shrinkage of aluminum is about one-quarter of an inch in a twelve-inch sample.

* From Machinery.

Although advisable to buy the aluminum crude castings already hardened, the purchaser may increase the hardness by adding zinc, manganese, tin, brass, nickel or other like metals. Aluminized zinc brass makes a most durable metal for knitting machine needle cams.

### PROCESS OF MAKING ALUMINUM CASTINGS FOR KNITTING MACHINERY.

Electrical machinery builders are now using this metal in places where strength is needed. For general purposes, however, a good alloy from which to make cams, bearing sleeves, small castings and the like for knitting machinery may be made as follows:

| | |
|---|---|
| Aluminum | 95·00 |
| Antimony | 3·04 |
| Tin | 0·96 |
| Copper | 0·94 |
| Tungsten | 0·06 |
| Total | 100·00 |

The tensile strength of parts made from this alloy is 26,000 lb. It can be cast in sand moulds. The melting and casting of aluminum alloys into knitting machinery parts requires an equipment something like that shown in the diagrams, the first of which is a sectional view of the melting pot or crucible, A, which is set up in a brick affair over a coke fire. Coke must be used, and not coal, as the gases from the latter are liable to impregnate the metal. The crucible can be balanced on a shaft, on which shaft should be keyed a gear. A worm shaft can be arranged to engage with the cogs as shown at F, and by turning this shaft with a handle at G, the crucible can be poured. The lid, B, is provided with a spout, C, the end of which can be closed with the cap, D. The latter is, of course, removed when the metal is poured. Next the ladle should be erected, as shown in section in Fig. 2, in which the ladle itself is marked A, and the pouring gate channel, F. This gate is stopped with the plug, C, and the latter raised and depressed by means of the shaft, D, and handle bar, E. By this arrangement the metal is poured from the bottom and scum is avoided. The arrangement of the mould does not differ enough from ordinary descriptions to call for detailed account.

The gate channel leads into the runner, G, and the metal flows through to the moulds, H and I. Perhaps in this connection it may be well to refer to the method of casting aluminum shuttles. The mould box is shown in sectional view in Fig. 3, and the gate for pouring is at C, where it branches off into the runner, and several shuttle moulds are connected with it. The core of the hollow of the shuttle is indicated at A, consisting of a correctly shaped metallic piece, wound with hemp and swept with loam. It is held in place by the stem, B. After the castings are taken from the moulds, the finishing processes call for the usual chipping, cleaning and smoothing. Some special wheels are used in the work, and these are shown in the next sketches, that in Fig. 4 being a side view of a "scratch" wheel made by covering a wood cylinder with medium sized fancy clothing wire. The use of this wheel is to remove fins, etc., from the castings. The next wheel (5) is covered with fine emery, for evening off the surfaces, and the last wheel (Fig. 6) is for buffing purposes, being covered with felt or pile fabric.

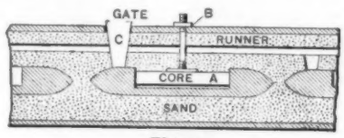



Fig. 3

Fig. 4

Fig. 5

Fig. 6

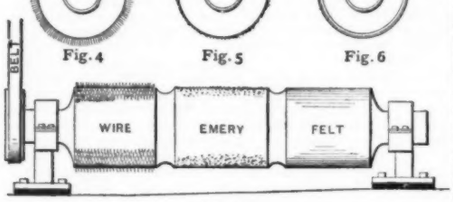



Fig. 7

These wheels may be set up separately in stands of wood and revolved by belts, or all may be arranged on one cylinder with a division between each, as shown in Fig. 7.

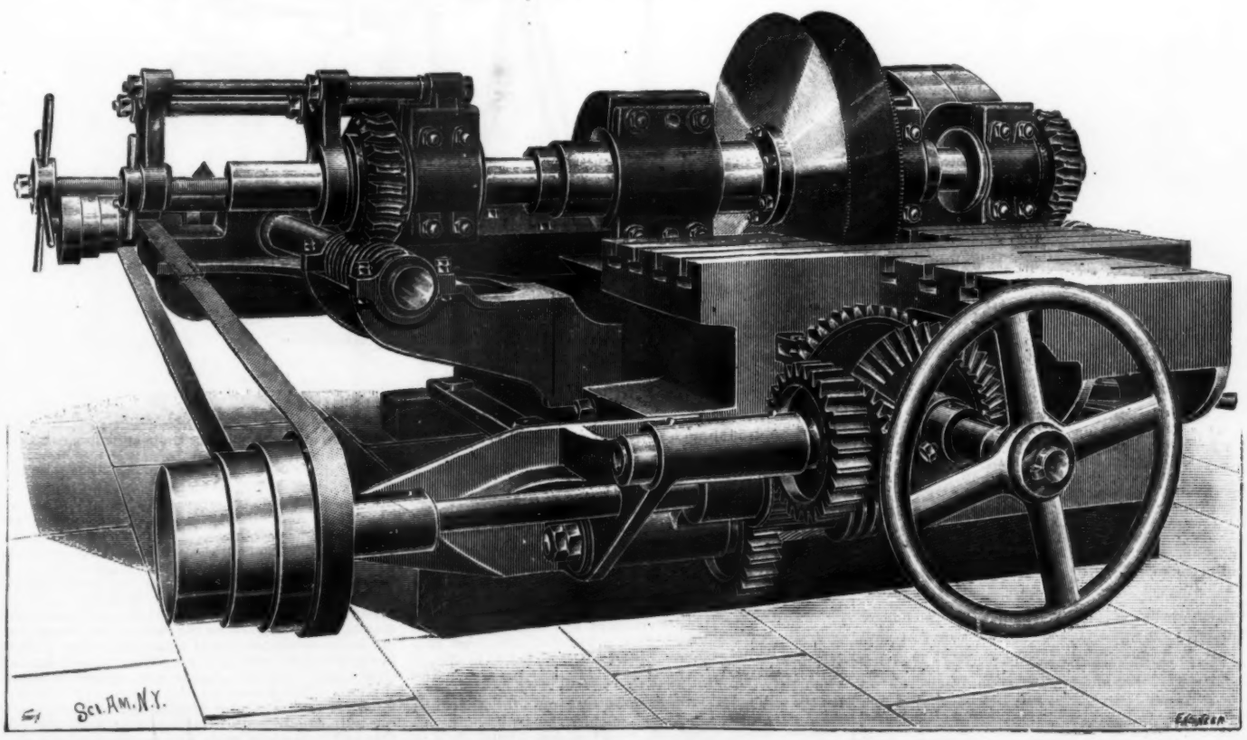
If the castings should prove too brittle, anneal them by heating to cherry red and dipping in cold water. Three points are claimed for the aluminum hollow castings. They are lighter, tougher and look better than iron or steel castings. On the other hand, they cost more, but not much more than iron or steel parts. Concerning looks, this is quite an item in these days, and if the aluminum alloy castings are given the so-called nickel polish, a very attractive machine is made. This nickel polish is easily and cheaply applied, consisting in buffing the surfaces of the castings or other aluminum parts, and putting on nickel rouge or crocus composition. The buffing is done in this case with soft muslin or loose cotton wheels. A shiny nickel-like polish results and sets off the knitting machine to advantage.

## A RAPID METHOD FOR THE DETERMINATION OF SILICON IN SILICO-SPIEGEL AND FERRO SILICON.

C. B. MURRAY and G. P. Maury, in the Journal of the American Chemical Society, 1897, 19, 138, 139, describe the following method: 0·5 gr. of the sample is placed in a porcelain or platinum dish; 50 c. c. of water, 10 c. c. of hydrochloric acid (sp. gr. 1·20), and 12 c. c. of sulphuric acid (one part of sulphuric acid [1·84 sp. gr.] to three parts of water) are poured on it, and the contents of the dish heated until copious fumes of sulphuric acid are given off. When cool, 10 c. c. of hydrochloric acid are added, and the whole is heated to soften the sulphate of iron; finally it is treated with 75 c. c. of water, and raised to boiling. The heating is discontinued, and note taken as to whether there is any effervescence when boiling ceases. Should this occur, the liquid must be evaporated until copious fumes of sulphuric acid are again given off, and then it is treated in the manner above described. The solution is filtered, washed with hydrochloric acid and hot water, ignited in a platinum crucible, and weighed. A few drops of sulphuric acid and enough hydrofluoric acid are added to dissolve the silica. The liquid is then evaporated to dryness, heated to decompose the sulphates, cooled and weighed. The difference in the two weights represents silica. The whole operation can be accomplished in thirty minutes.

## COLD SAW FOR CRANK WEBS.

THE accompanying engraving illustrates a heavy cold saw just constructed for a Midland firm by Messrs. Hill & Sons, St. George's Works, Derby. It is specially intended for sawing out crank webs. Each saw is fitted with the makers' patent flush sides. One is stationary, the other is movable to suit the traverse of the telescopic saw spindle. The engraving is self-explanatory.—The Engineer.




SAW FOR CRANK WEBS.

[Continued from SUPPLEMENT, No. 1130, page 18059.]

## PERPETUAL MOTION.—II.*

THE two self-movers, which it has been claimed were really such, were the inventions of the Marquis of Worcester, author of the "Century of Inventions," and Jean Ernest Elie-Bessler Orffyre, or Orphyrreus, who is usually named Orffyreus in English and German works. The latter was born in 1680 near Zittau, in the department of Alsace, France, and early studied theology and medicine, but his erratic genius was only to be satisfied by engaging himself in the pursuit of a variety of the mechanical arts and painting. He asserts that it was during his search for whatever might prove curious and valuable that he discovered perpetual motion, and between the years 1712 and 1719 made two machines on his system; one he desired to exhibit publicly, but broke it up rather than submit to the payment of the license or tax required by the government of Cassel; the other he destroyed after its having been unfavorably reported on by M.'S Gravesande. He published in German and Latin a book or pamphlet entitled "Le Mouvement Perpétuel Triomphant," quarto, dated Cassel, 1719. Other accounts differ respecting the breaking of the second machine, and, on insufficient authority, Mr. Partington styles him a "German mechanic." Dr. William Kenrick, among his miscellaneous works, wrote "An Account of the Automaton or Perpetual Motion of Orffyreus, with additional remarks," in editions dated 1770 and 1771. Orffyreus died in November, 1745.

The following is a description of the Marquis of Worcester's wheel, described in the 56th article of the "Century of Inventions" as "An Advantageous Change of Centers."

"To prouide and make that all y^e^ weights of y^e^ defcending syde of a wheele shal be perpetually further from y^e^ center, then thofe of y^e^ mounting syde, and yett equal in number and heft of y^e^ one syde as y^e^ other. A most incredible thing if not seene, butt tryed before y^e^ late King of happy and glorious memorye in y^e^ Tower by my directions, two Extraordinary Embaffadors accompanying his Ma^tie^ and y^e^ D. of Richmond, D. Hamilton, and most part of y^e^ Court attending him. The wheele was 14 foote ouer, and 40 weights of 50 p^d^ apiece; S Wm. Belford, then Lieu^t^ of y^e^ Tower, and yet liuing can justify it with seuerall others; they all saw that noe sooner these great weights passed y^e^ Diameter Line of y^e^ vpper syde but they hung a foote further from y^e^ center, nor no sooner passed the Diameter line of the lower syde, butt they hung a foote nearer; bee pleased to judge y^e^ consequence."

Of the inventions of these two men Dircks says:

"The only appeal that can be made in apology for the pursuit of perpetual motion is derivable from the results represented to have been obtained by the Marquis of Worcester in one instance and by Orffyreus in another. All the circumstances relating to their singular inventions excite our curiosity, raise our skepticism and induce us to pause in our decision. Let us first consider the inventors personally; and, secondly, their inventions and the circumstances attending their exhibition. The two men were of very different character and position in life. The first noble by birth, of ancient lineage, loyal to the extent of sacrificing his property in support of the cause of Charles I, and evidencing by his prayers his truly religious sentiments. About or before 1648 (as the King died 1649), he exhibited his wheel or perpetual motion in the Tower before his Majesty, two extraordinary ambassadors, the Duke of Richmond, Duke Hamilton, most part of the Court and Sir William Belford, Lord Lieutenant of the Tower. We have to consider the upright character of the Marquis, his having invented the steam engine, his worthiness in all respects and the circumstances here detailed, and then ask ourselves: Little as science favors any belief in such an invention, can we see any reasonable grounds for error in this great experiment, or believe that a person so distinguished and so much to be admired in all other respects could thus boldly and recklessly deceive himself, his noble company and the public, taking ten years or upward to elaborate and record a gross falsehood? It seems incredible, and true respect for the marquis' memory will go far to maintain doubts respecting the infallibility of all mathematical demonstrations adverse to the possibility of a self-motive power. Secondly:

"Orffyreus was of humble origin, had versatile talents, and fickle, discontented, unsettled, irregular, and eccentric. He was ambitious, boasting and the very man to raise up enemies. Between 1712 and 1718 he made and destroyed in succession four wheels or machines. He had learned the art of clock making and several mechanical arts, and is supposed to have constructed or put these wheels together himself. He had a princely patron who wished to obtain practical results from the invention for manufacturing and other operations. A misunderstanding ensues; and from that time to his death, in 1745—at least twenty-eight years—the subject lies dormant and the invention dies with him. This last fact, coupled with the wheel having raised so great a weight as 70 pounds, makes a doubtful case still more doubtful; and particularly when, about the same time, Geiser imposed on the German public with a mere piece of clockwork as a true perpetual motion.

"The Marquis of Worcester's wheel was 14 feet in diameter; it was rotated by the action of forty 50 pound weights—2,000 pounds—an enormous weight, requiring some very laborious operations of the carpenter to erect a sufficiently strong framework. Its completion must have taken some time and led to frequent visits from the noble inventor, as well as experiments to test its correct working before offering a practical demonstration before majesty.

"Orffyreus' fourth or last wheel, at Hesse Cassel, was 12 feet in diameter, 14 inches broad and made of light oak framing and covered with oil cloth. It would revolve either way, and this alone casts a shade of doubt on there being any deception in practice with it. But, strange to say, it had power enough to raise 70 pounds to a considerable height. Its operations were seen and attested by so many that these broad facts rest not alone on the inventor's authority. It was so ingeniously made that M. Gravesande wrote to Sir Isaac Newton on the subject; and his letter and mathematical reasonings in reference to the matter appear in his works, edited by Prof. Lalande, 1774."

* Reprinted from the SCIENTIFIC AMERICAN, 1870-71.

The following is the letter written by Prof. S. Gravesande to Sir Isaac Newton in regard to the wheel of Orffyreus:

Sir: Dr. Desaguliers has doubtless shown you the letter that Baron Fischer wrote to him some time ago about the wheel of Orffyreus, which the inventor affirms to be a perpetual motion. The landgrave, who is a lover of the sciences and fine arts, and neglects no opportunity to encourage the several discoveries and improvements that are presented him, was desirous of having this machine made known to the world for the sake of public utility. To this end he engaged me to examine it; wishing that, if it should be found to answer the pretensions of the inventor, it might be made known to persons of greater abilities, who might deduce from it those services which are naturally to be expected from so singular an invention. You will not be displeased, I presume, with a circumstantial account of this examination. I transmit you, therefore, a detail of the most particular circumstances observable on an exterior view of a machine, concerning which the sentiments of most people are greatly divided, while almost

FIG. 5.

all the mathematicians are against it. The majority maintain the impossibility of a perpetual motion, and hence it is that so little attention hath been paid to Orffyreus and his invention.

For my part, however, though I confess my abilities inferior to those of many who have given their demonstrations of this impossibility, yet I will communicate to you the real sentiments with which I entered on the examination of this machine. It is now more than seven years since I conceived I discovered the paralogism of those demonstrations, in that, though true in themselves, they were not applicable to all possible machines, and have ever since remained perfectly persuaded it might be demonstrated that a perpetual motion involved no contradiction; it appearing to me that Leibnitz was wrong in laying down the impossibility of the perpetual motion as an axiom. Notwithstanding this persuasion, however, I was far from believing Orffyreus capable of making such a discovery, looking upon it as an invention not to be made (if ever) till after many other previous discoveries. But since I have examined the machine, it is impossible for me to express my surprise.

The inventor has a turn for mechanics, but is far from being a profound mathematician, and yet his machine hath something in it prodigiously astonishing, even though it should be an imposition. The following is a description of the external parts of the machine, the inside of which the inventor will not permit to be seen, lest any one should rob him of his secret. It is a hollow wheel or kind of drum about 14 inches thick and 12 feet diameter, being very light, as it consists of several cross pieces of wood framed together, the whole of which is covered over with canvas to prevent the inside from being seen. Through the center of this wheel or drum runs an axis of about six inches diameter, terminated at both ends by iron axes of about three-quarters of an inch diameter upon which the machine turns. I have examined these axes, and am firmly persuaded that nothing from without the wheel in the least contributes to its motion. When I turned it but gently, it always stood still as soon as I took away my hand; but when I gave it any tolerable degree of velocity, I was always obliged to stop it again by force; for when I let it go, it acquired in two or three turns its greatest velocity, after which it revolved for twenty-five or twenty-six times a minute. This motion it preserved some time ago for two months in an apartment of the castle, the doors and windows of which were locked and sealed, so that there was no possibility of fraud. At the expiration of that term indeed his serene highness ordered the apartment to be opened and the machine to be stopped, lest, as it was only a model, the parts might suffer by so much agitation. The landgrave being himself present on my examination of this machine, I took the liberty to ask him, as he had seen the inside of it, whether, after being in motion for a certain time, no alteration was made in the component parts; or whether none of those parts might be suspected of concealing some fraud; on which his serene highness assured me to the contrary, and that the machine was very simple.

You see, sir, I have not had any absolute demonstration that the principle of motion, which is certainly within the wheel, is really a principle of perpetual motion; but at the same time it cannot be denied that I have received very good reasons to think so, which is a strong presumption in favor of the inventor. The landgrave hath made Orffyreus a very handsome present to be let into the secret of the machine, under an engagement, nevertheless, not to discover or to make any use of it before the inventor may procure a sufficient reward for making his discovery public.

I am very sensible, sir, that it is in England only the arts and sciences are so generally cultivated as to afford any prospect of the inventor's acquiring a reward adequate to this discovery. He requires nothing more than the assurance of having it paid him in case his machine is found to be really a perpetual motion; and as he desires nothing more than this assurance till the construction of the machine be displayed and fairly examined, it cannot be expected he should submit to such examination before such assurance be given him. Now, sir, as it would conduce to public utility, as well as to the advancement of science, to discover the reality or the fraud of this invention, I conceive the relation of the above circumstances could not fail of being acceptable.

Partington, in his "Manual of Natural Philosophy," endeavors to interpret the somewhat enigmatical specification of the Marquis of Worcester by the accompanying diagram, Fig. 5, which it is self-evident almost at a glance can have no movement except that derived from external forces.

Making a long jump from the remote to the near, we shall next present an illustration of a perpetual motion machine invented by Horace Wickham, Jr., of Chicago, Ill., and on which a patent was obtained July 26, 1870. Mr. Wickham will thank us for placing him in such honorable company as the Marquis of Worcester, and our readers will perhaps be glad to see the form and essence of a machine which Western journals have greatly lauded as most wonderfully ingenious, etc., though if they can see how it generates any motive power, their mental vision will be superior to ours.

A is the bed or table upon which the standards for supporting different parts of the machine are secured. B B are the standards for supporting rocking beam, C. This rocking beam is pivoted at the center to the standards by the ring, D, and set screws. These centers have points like lathe centers. The other parts of the machine consist of a governor, fly wheel, etc.

C is the rocking beam, constructed in two parts and secured together by the bands, E. The rocking beam consists of two tubes; the upper one is made straight

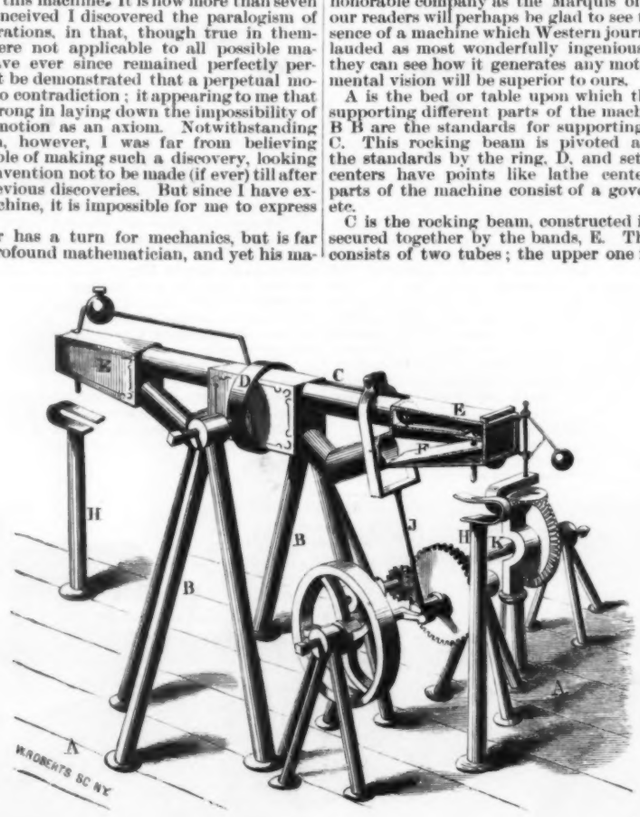



FIG. 6.

and the lower one in the form of a W. These tubes are connected together at their ends in such a manner as to allow the ball used to pass from the lower tube to the upper one by means of hinged inclined runways, F, and valve, G, and from the upper one to the lower, inside of the band, E, by the opening therein. The inclined runway, C, is hinged at one end to the upper tube, F, at the bottom of its opening or exit, inside of the band, E, while the other end rests on the valve, G.

This valve has attached on its under side a pin which projects down through a hole in the band, E, a sufficient distance, so that, when the pin strikes the standard, H, secured to the bed or table, as the rocking beam oscillates it will raise the valve a short distance above the upper tube. The valve is made to incline toward the opening in the upper tube, so that the ball, when raised on the valve, will roll into the same, by means of the hinged inclined runway, F. I is a ball which runs in the upper and lower tubes; this ball is charged with a necessary amount of quicksilver, for giving more weight to the same, and also for giving a much quicker momentum to the ball. This

ball is to be used in the rocking beam for the purpose of unbalancing, and also to exert the pressure of its specific gravity on the same at whatever point or position it may be in, and in so doing it assists in oscillating it.

The pitman, J, connects the crank shaft with the oscillating beam. The rocking beam is provided, on the opposite end to which the pitman is attached, with a rod, on which is placed an adjustable weight, which is secured at any desired point by means of a set screw. This weight is for the purpose of counterbalancing the adjustable band provided with a rod to which the pitman is attached, and also the pitman. The governor is for the purpose of regulating the motion of the

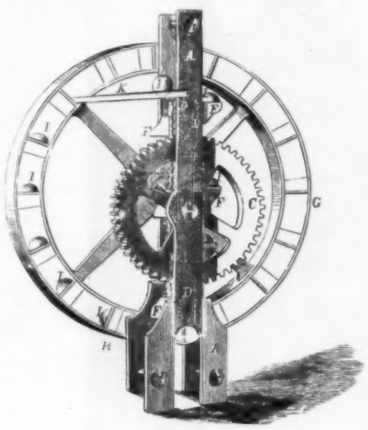


FIG. 7.

machine, and is operated through the medium of a gear wheel on the crank shaft, and other suitable gearing. The governor is constructed in the usual manner, excepting in using the cutoff valve, as in steam engines, which is dispensed with, and an automatic brake is used and operated by means of the rise and fall of the governor balls. The automatic brake consists of an elastic band, one end of which passes up through a hole in the guide rod projecting from the standard that supports the governor, and is connected to an arm projecting toward and partly around the upright shaft of the governor.

The tension of the band is regulated by nuts and screw-thread on the end of the band. The other end of the band passes under a wheel on the shaft, K, and is secured to a projecting arm on the standard that supports the governor. The crank shaft is counterbalanced.

I do not wish to confine myself to the precise construction of the rocking beam, as shown and described, as I intend using, in lieu thereof, wires, or rods, arranged in the form and shape of the rocking beam described, with mounted weights arranged to roll on them, which, in connection with the other parts of the machine, will accomplish the same result.

The lower tube can be made semicircular in form and shape instead of the form and shape of a W. Any number of rocking beams may be used, and more than one ball can be used in the rocking beam, by having inclined runways and valves on each end of said beam; the rocking beam so arranged that the balls drop from one tube to the other at the center of the beam,

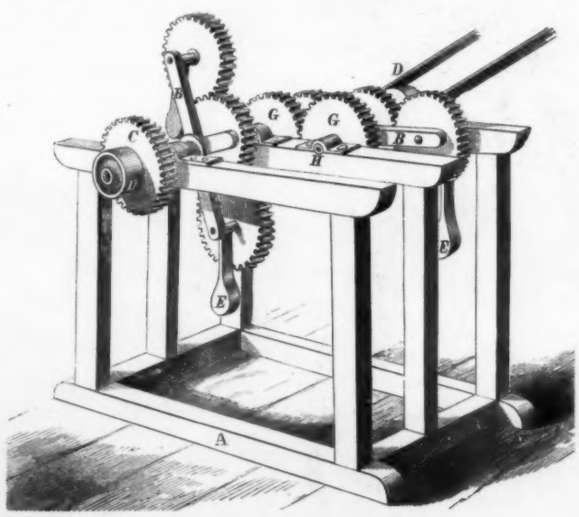


FIG. 9

and rolling alternately from the center to the ends of the beam.

The rocking beam is oscillated by any power operating alternately on each end of the same, and which transmits motion to the other parts of the machine through the medium of the pitman and crank shaft, and for applying power to any other machine a pitman is secured on the opposite side of the rocking beam to which the pitman, J, is attached, or, instead thereof, pulleys, and endless belts on the shaft, K, or the crank shaft.

The spokes of the fly wheel are charged with quicksilver, for the purpose of giving weight to the same at any desired point, as it passes from the center to the circumference of the wheel.

It is claimed that this machine has run seven months without stopping, independent of any external force, which we do not believe, and we think our readers, after reading the above description of it, abstracted from the specification on file in the Patent Office, will concur with us in our belief.

In 1790, one Conradus Schwiers, a doctor of divinity, patented a "machine on a self-moving principle, or perpetual motion." Fig. 7 is a view of this machine, which, it will be at once seen, is an effort, since often repeated, to obtain a wheel so as to keep its center of gravity from ever falling directly under the axis while revolving. The following is the specification:

"Now know ye, that in obedience of the said letters patent, and the proviso therein contained, I, the said Conradus Schwiers, do hereby declare my said new invented self-moving principle, or perpetual motion, is made and performed in manner following, that is to say:

"Two stiles or uprights marked in the plan hereunto annexed, A, A, etc., and fastened together by the screws, 1, 2, 3, and to the base, between which stiles or uprights run the wheel, C, and the pinion, D, and the two double pinions, D, D, etc., over which double pinions run a double chain, etc., to which chain are fixed the buckets, F, F, etc. The chain is made with joints on each side and bars running across, equal in number to the cogs of the wheel, C. Upon the same axle with the wheel, C, on the farther side of the inner stile, A, runs the wheel, G, whose diameter is full double that of the wheel, C; and the pivot of the wheel, G, runs in the back, H, as the other pivot of the same axle runs in the front stile, A. The wheel, G, is divided near the periphery into receptacles in number equal to the buckets on the chain, which receptacles are supplied with metal balls, I, I, etc., from the buckets, F, F, etc., by means of the gutter, K, which balls by their weight forcing round the wheel, G, and thereby lifting up the buckets, F, F, etc., on one side as they go down on the other side, discharge themselves again at the bucket, L, where they are taken up by the buckets, F, F, etc., and discharged again at the gutter, K, and are so repeated in a constant succession as often as any receptacle is vacant in the wheel, G, at the gutter, K, for their reception, and by that means the perpetual revolution is obtained, the upper ball being at the same time discharged from one bucket when the lower ball is taken up by another." A very common principle has been worked out to uniform failure in various ways, from the earliest to the latest times. It is shown in the accompanying diagram, Fig. 8, which represents a large wheel, the circumference of which is furnished, at equal distances, with levers, each bearing at its extremity a weight, and movable on a hinge, so that in one direction they can rest upon the circumference, while on the opposite side, being carried away by the weight at the extremity, they are obliged to arrange themselves in the direction of the radius continued. This being supposed, it is evident that when the wheel turns in the direction, a, b, c, the weights, A, B, and C, will recede from the center; consequently, as they act with more force, they will carry the wheel toward that side; and as a new lever will be thrown out, in proportion as the wheel revolves, it thence follows, say they, that the wheel will continue to move in the same direction. But, notwithstanding the specious appearance of this reasoning, experience has proved that the machine will not go; and it may indeed be demonstrated that there is a certain position in which the center of gravity of all these weights is in the vertical plane passing through the point of suspension, and that therefore it must stop.

Fit companions to these remarkable specimens of false reasoning are the two modern devices of which we give illustrations in Figs. 9 and 10.

Fig. 9 represents a device by Charles Batcheller, of Polk County, Iowa, on which he took out a patent during 1870.

"My invention is designed to provide a simple balance power, that may be advantageously used in connection with any machinery where a balance wheel or fly wheel is used or may be used. By my combination of levers, weights, and gearing, I create a compound power that is perfectly balanced when at rest. Thus far it is similar to a common fly wheel. But less force is required to put my compound wheel in motion, and, after being started, it accumulates a greater power, and much more rapidly, than an ordinary balance wheel. The degree of power actually gained has not been accurately determined. In addition to the increase of power I gain an increase of speed. While my compound balance lever power makes one revolution, the inside shafts and wheels thereto attached make two revolutions. The illustration is a perspective view of my compound balance lever mounted on a frame. A is the frame. B represents pieces forming frames, in each of which are hung three geared wheels. There are two of these frames and two sets of those geared wheels. C is a geared wheel, which can be used for communicating power. D, belt wheels, which are also used to communicate power. These can be used at the same time, one on each side; and in place of the belt wheels and belting, geared wheels may be substituted. E represents weighted levers firmly secured to the axes of the geared wheels. There are four of these weighted levers, but only three shown in the illustration. G represents geared wheels secured on the hollow shafts, H, together with the frames, B. There are two of the geared wheels, and they are so placed that they connect the two sets of wheels and weights. By this connection the balancing power is formed. The frames, B, and the wheels, G,

FIG. 8.

are secured upon the hollow shafts, so that they cannot move independent of each other. Shafts are placed within the hollow shafts, H, upon which the communicating wheels, D, and the center wheels are secured, so that they can move independent of the frames, B, and wheels, G. While the frames, B, make one revolution, the wheels, D, and the center wheels, make two revolutions. This is caused by the action of the weighted levers, E. Their weight, or inertia, prevents them from passing around the center of the axis of the wheels with which they are suspended in the revolving frames. The full force of this resistance, or inertia, is applied to the other wheels of each set, and by these wheels communicated to the center wheel.

"The size and weight of this compound balance lever power may be varied and adapted to the various uses to which it may be applied."

Fig. 10 is a device of Doctor Alois Drasch, of St. Egidi, Austria, patented in the United States, December 22, 1868.

"This invention consists in the arrangement of an annular tilting tray, which forms the orbit for a revolving ball, in combination with a supporting platform, and with a lever which extends into the tray and connects with a shaft, to which motion is to be imparted, in such a manner that, by continually changing the position of the

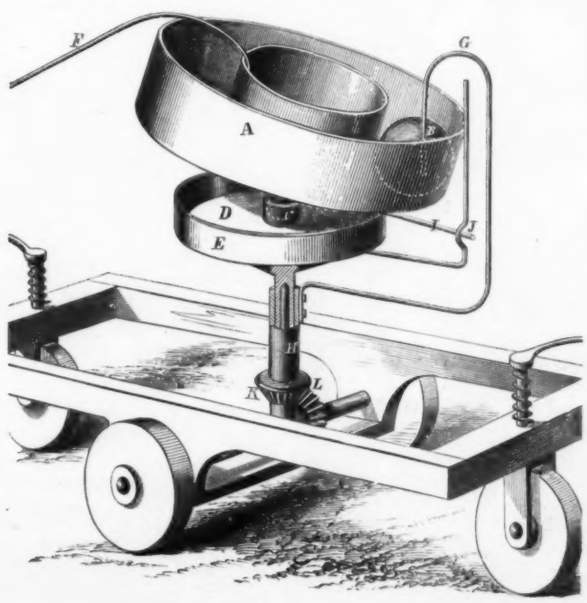


FIG. 10.

tray, the ball is caused to rotate therein without interruption, and by the action of the rotating ball on the lever the desired motion is imparted to the shaft, which connects with the working machines or mechanism to be driven. A represents a tray, which forms an annular path, or orbit, for the ball, B. This tray is made of sheet metal, or any other suitable material, and its diameter is about four times that of the ball, B. It is supported in its center by a rod, which connects, by a ball and socket joint, C, with a platform, D, so that said tray can be readily tilted in any desired direction. From the edge of the platform, D, rises a circular rim, E, which prevents the tray from being tilted any lower than desirable. The position of the tray is governed by a hand lever, F, which enables the operator to con-

tinually tilt said tray in advance of the rotating ball, so that said ball is kept rolling on a continually changing inclined plane; and, as the ball progresses in its orbit, it bears on a lever, G, which extends from the shaft, H, into the tray, as shown in the drawing. The tray is guided in its tilting motion by an arm, I, which is firmly attached to its circumference, and catches in a loop, J, secured to the edge of the platform, D. The shaft, H, is intended to transmit the motion, imparted to it by the action of the ball, B, to the working machines, or to a mechanism of any desired construction.

"In the drawing, my motor is shown as applied for propelling a railroad car, or vehicle, and in this case the shaft, H, bears a bevel wheel, K, which gears into a similar bevel wheel, L, mounted on the axle of the car, or vehicle, so that the rotary motion imparted to the shaft, F, will be transmitted to the axle of the car, or vehicle, and the desired motion of said car, or vehicle, will be effected. It is obvious, however, that my rotary ball motor is applicable for the purpose of driving machinery of any kind, and it is particularly valuable in localities where the erection of a steam engine, or other motor, would be difficult or impracticable."

(To be continued.)

## THE STOCKHOLM EXHIBITION.

A SPECIAL charm has been added the past summer to the many attractions of the beautiful Swedish capital Stockholm. In close proximity to the town, bounded on one side by the wooded slopes of the zoological garden, on the other by the extended cliffs of the Baltic, an exhibition of productions of the North spreads gay life around. But not only by its beautiful site is the exhibition distinguished. It is marked by a general excellence in the artistic and clever arrangement of its rich and interesting array of exhibits. It brings before our eyes the commerce and industry, the social life and the educational progress of a hard working people, a people which, notwithstanding its modesty, is fully conscious of its own power, and which at this exhibition proves to the world that intelligence and carefully trained talent place it on a par with the other civilized nations in the great strife of culture and industry.

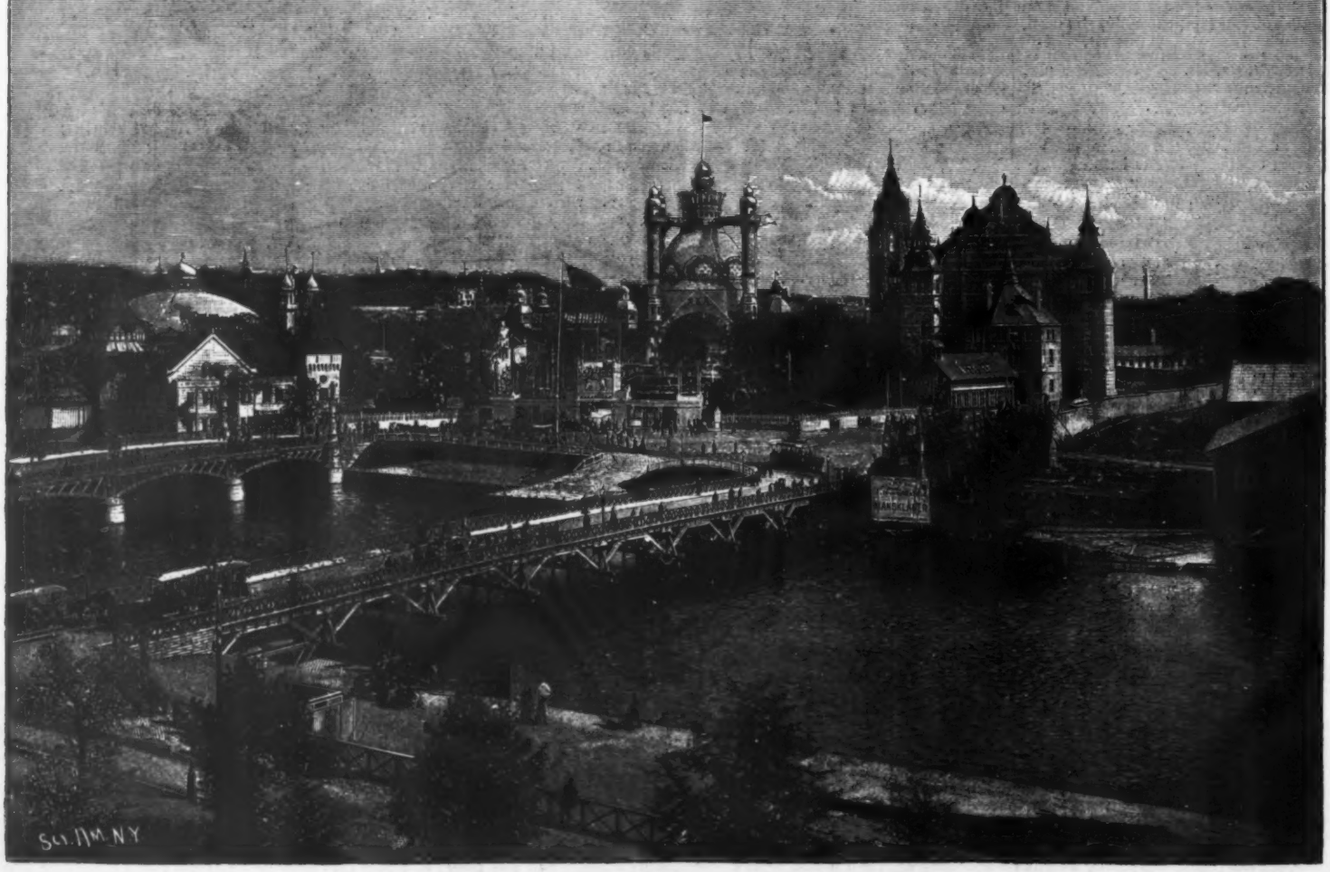
Another merit of this exhibition is its freedom from those worthless shows, calculated to satisfy the tastes of a mixed public, which have lately infested many of the over-numerous exhibitions opened throughout Europe. The Stockholm exhibition has a dignified reserve which was well in keeping with the refined, industrious, national character of the Swede.

Much of the success was due to the assiduous efforts of the Crown Prince, who, as patron, not merely nominally but actively supported the enterprise. Wherever a difficulty arose his helping hand was felt, and he again found a ready counselor and supporter in his father, King Oscar II. The younger prince, too, Gustavus, himself a talented painter, paid much attention to the management of the art department of the exhibition. With such influential personages exerting all in their power toward the successful development of the undertaking, this rapidly grew in extent to an unexpected size, Denmark and Russia competing with additional zeal. When, therefore, in May, King Oscar opened the exhibition with an appropriate speech, his words were greeted with shouts of joy and cheers of applause, in honor of the Stockholm Exhibition, a completed and wonderful work, filling all with admiration for the good taste and the zeal of its promoters.

OLD STOCKHOLM.

The great variety by which this exhibition was marked shows itself already in the exterior of the buildings. These, extending over 3,900,000 square feet, differ greatly in style, all buildings being represented, from the massive Gothic and the graceful rococo to the pretty Norse wood cottages, with colored façades, harmonizing most perfectly with the picturesque surroundings.

Immediately upon entering by the main gate we are confronted by a contrast. On the right we have the somber brick built northern museum, and in front is the great central palace, raised of wood only, in charming variety, crowned with a many colored cupola,



INDUSTRIAL AND ART EXHIBITION, STOCKHOLM, SWEDEN.

which is connected to four graceful minarets by slender bridges. The whole with its delicate façade reminds us of a Hindoo temple. To these minarets elevators raise the visitors, who from the height may enjoy a view over the whole exhibition grounds, and over the grand scenery of woods and waters around, which surround the beautiful city of Stockholm, with its grand palaces and churches, its ever busy streets and squares. In the rooms of the northern museum we find departments for education, instruction, science, hygiene and domestic industry, which last finds special support and stimulus from the Swedish government.

In this department we see real wonders in woman's work: the most beautiful embroidery, often with ancient Swedish designs, painted wood carving of exquisite shape, woven carpets and curtains, lace and allied work, even furniture in peculiar shapes and colors. The work of children, too, deserves our attention, for the elder workers would never have attained their perfection, had they not learned early to use their tools and material.

The central palace holds the industrial productions of Scandinavia, Denmark, and Russia. Here, too, our interest is fanned by the great variety, for the different realms have each separate industries, of which they represent their greatest and best at this exhibition. Thus Sweden shows artistic gold, silver and steel work, besides beautiful porcelain, which equals the Danish china in its peculiar coloration and its polish. Sweden also exhibits costly furs, fine marble and granite. Norway has first wood industry, then also metal work finished with extreme care, while in Russia's array we find bronzes and enamels. These are, of course, but a few of the numberless exhibits. Norway, of course, gave special attention to the late Nansen expedition, a model of the Fram, some remaining provisions, showing that the men were not hard pressed by hunger, a few weapons and some hunting trophies of the daring explorer, such as polar bears, skins, etc., also relics, as his sealskin jacket, and his small boat and sledge, are there to remind us of his adventurous and fortunate journey north. Two of his faithful dogs, that followed him, are here to be seen stuffed.

Near these two buildings, the northern museum and the central palace, are a number of pretty pavilions, serving for various special exhibitions and for entertainments of an instructive character. Thus there is a pavilion for sport and touring, including artistic panoramas, the most exhaustive outfits for traveling, mountaineering, glacier climbing and snowshoeing, for land and water sports of every kind. Then a pavilion for chemical industries, the pavilion of the city of Stockholm, built in rococo style, and holding all that is interesting in the public and social organization of the town; very practical are the school and the ambulance arrangements, worthy of imitation the courses in housekeeping, etc., for young girls. The underground arrangement of sewers, gas mains, etc., is made plain by a vertical section reproduced in full size. With its wood carved façade turned toward the water stands the building of the Swedish-Danish fisheries. It is built in brown wood; its exhibits offer much that is of interest and novelty even to the initiated. The models of crafts serving partly for passenger and freight transport, partly for fishing, are a great attraction. To this building is attached another devoted to Norwegian fisheries, and showing of what importance this trade is to the nation. The outfits for whaling and hunting the seal are here the features of chief interest. The riches of the Swedish forests are gathered together in a pavilion, of which the log walls and moss covered roof are sufficient indication as regards its contents. Here, too, a fine panorama supplements the well arranged collection, as also in the biological museum close by, which has been located in a quaint old peasant's cottage. This in itself is quite a curiosity. In it we see the great variety of animals found in Scandinavia represented by exquisitely stuffed specimens. Then, rising upon a neighboring hill, stands the pavilion of the Royal Hunting Club, whose president is the Crown Prince, and by whose members a considerable portion of the exhibits were secured. A little further we come to the shining white exhibition of Swedish music and drama, with many historical memorials and a large concert hall. Here the compositions of the most eminent of Swedish masters of this century are rendered by first class musicians.

Along the banks of the Djurgarden-Väken old Stockholm extends with its walls and turrets, its ramparts and ditches, defended by a number of quaintly shaped weapons, erstwhile perilous to the enemy, and guarded by martial looking lansquenets in the becoming uniform of the days of Gustavus Adolphus. This model of ancient Stockholm, with its narrow, crooked streets, full of antique houses, with workshops and inns, a church and the city hall, is one of the most perfect productions of its kind ever seen. In none of the representations of old towns used at exhibitions upon so many occasions within the last decade was the visitor so impressed by a feeling of reality as here. Not only is the whole construction kept very true to nature and history, but the gable houses are built of solid material, and touch us with a homely feeling, calling to memory the days of long ago. Close to the water, on a large scale, is built the old royal castle, the "Tre Kroner." Within its castle yard it is easy to fancy one's self back to past centuries, for everything here is in wonderful harmony, making one forget the present: the surrounding ramparts, with their narrow drawbridges, the castle yard with its low outlets to prison den-like vaults, the staircases to the inner halls and chambers, and, lastly, the view from the porch over the market place, which in days gone by resounded on many an occasion with the clash of arms and the battle cry.

To-day peace reigns over the land. Sweden, once the home of such great warriors as Gustavus Adolphus, is now friendly to the neighboring states. But that it is able in the case of need to make a stand for liberty we are convinced when we visit the white palace of the navy and army department. This stands in the second western part of the exhibition, and the strength of Sweden by land and by water is here clearly demonstrated. We are made acquainted with the internal organization of the army and navy, and we are shown what a stress is laid by the government on the mental and physical development of the people. In lifelike groups the various army divisions are placed before us. The uniforms are becoming and practical, the officers and soldiers are marked by their modest bearing. The artillery is represented in particular completeness, partly here and partly in the pavilion for iron and steel industry. By models the rapid development of the Swedish navy is graphically demonstrated.

From the very water's edge extends the great machinery hall, built solely of glass and iron, and behind it, on a higher level, the white building of the art gallery, where nearly all nations of Europe were represented. But one of the most interesting exhibits is stationed close [illegible] great steel-built steamer Södra Sverige, [illegible] sank in the "Schären" (cliffs), in 1895, on the journey to St. Petersburg, and lay for nearly two years at a depth of some two hundred feet, to be raised to the surface again quite lately by an ingenious device, the invention of the engineer Waller, and to be brought to the exhibition by steam. When the boat, which is worth some $125,000, has undergone some further repair, it will again be quite seaworthy. One more item must be mentioned before we close our account of this exhibition—that is the Skansen, a thing unique in its kind, a national museum in openair. Overshadowed by gigantic northern trees, there are collected here a number of peasant cottages, which have been transported hither with inhabitants and all their domestic utensils and furniture from the various parts of the land, giving us a perfectly true picture of Swedish country life. The Skansen was founded by Prof. Harzelius at the beginning of this decade, and has since prospered, increasing visibly from year to year, owing to vivid interest taken in its welfare.

The exhibition was held in honor of the twenty-fifth anniversary of the present king's coronation. No better or more worthy gift could the nation have brought its ruler, for by it is shown the progress in all branches of industry which has attended the peaceful reign of the monarch, and no mean compliment is thus paid with great delicacy to King Oscar II. of Sweden.

The illustrations accompanying our article are from Ueber Land und Meer.

THE NEW RUSSIAN CHURCH IN KARLSBAD.

## THE NEW RUSSIAN CHURCH AT KARLSBAD, BOHEMIA.

A FEW weeks ago Karlsbad saw the inauguration of a Greek Catholic church. The new building does not only fill a long felt want in that much frequented summer resort, but it also figures highly among the great architectural sights of the city. The erection of a Greek Catholic church for the use of the Russian guests had long been contemplated. In 1866 Washington House, a building in the Marienbaderstrasse, was purchased, and by the work of the architect Mayblum transformed into a hall for religious services. But soon its capacity was found insufficient for the growing number of visitors. A piece of land on the Parkstrasse was bought as a site for a new church, the funds being partly presented by Russian guests who had sought and found health at Karlsbad, and partly granted by the Russian ministry, and by Pobjedonoszew, the procurator of the holy synod. Thanks to further donations the foundation stone could at last be laid on July 11, 1893. The plan of the church was designed in the Russo-Byzantine style of the eighteenth century by the architect Wiedermann, of Franzensbad. The forthcoming funds enabled the architect to set to work with such decision that on June 9 the building was ready for consecration. At this celebration the prior of the Kasan Church, St. Petersburg, assisted by archdeacons from Vienna, Budapest, Dresden, and Wiesbaden, performed the festal rites, whereupon the actual consecration was conducted by the Archdean Apraxin, the ecclesiastical head of the orthodox community of Karlsbad. The church was dedicated to St. Paul and St. Peter.

The building stands on a terrace which rises from the upper part of the Parkstrasse, a flight of steps leading up into the church from that street forming the main entrance. The roof is crowned with one central cupola of peculiar onion shape and a number of smaller ones of the same structure, grouped around it. One of these smaller cupolas forms the top of a pointed steeple in the back of the building. The walls are externally decorated by frescoes representing Christ crucified, and the two apostles to which the church is dedicated. The fine sculptures with which the interior of the church is adorned were fashioned by the artist Watzek, of Fischern.

The Czar showed his interest in the newly erected church by sending the secretary of the embassy at Vienna to represent him at the consecration services, and by decorating with medals the masters who directed the construction, a few of those who by donations and otherwise helped the enterprise being also similarly favored.

We are indebted for our reproduction of the building to Illustrirte Zeitung.

## THE SUBSISTENCE QUESTION IN THE KLONDIKE REGION.

THE situation in the Klondike region is in some respects similar, as regards subsistence, to the situation that existed in the Selkirk Range, west of the Rockies, in the winter of 1884–85, prior to the construction of the Canadian Pacific Railway. The end of the track of the railroad (corresponding to the end of water transportation at Dyea) was on the west slope of the Rockies, in the Kicking Horse Valley. Some 50 miles beyond lay the Selkirk Range, which the railroad was to cross at an elevation of about 4,000 ft. above sea level. This range had the name of being one of the most difficult ranges in the Northwest to cross even in summer and on foot. It was covered with fallen timber of great size, trees of eight and ten feet diameter sometimes lying two or three deep. No feed grew there for pack animals,

except for a few weeks and in a very few places. The slopes of the valleys of the Beaver and Illecillewaet Rivers were marked with traces of hundreds of snowslides. The Indians of that region could never be induced to cross the range after October. The old guides, returning eastward from the range in October, insisted that the snowslides would destroy any parties sent in there in the winter. The average yearly snowfall on the upper part of the Selkirk Range is twenty-five feet, giving from eight to ten feet depth of settled snow on the level.

A pack trail had been completed across the range by the fall of 1884, and the wagon road had been advanced part way up the east slope of the range. In October orders came from Montreal to attempt at least some parts of the work on the range. These were the heavy work intended to be built at the Albert Cañon on the west slope; the completion of the wagon road across the range to a connection with the road from the west, and the forcing in of supplies over the route as far as possible. The writer was ordered to take charge of the advance work on the west slope, and to see that ample supplies were taken in, for which work abundant pack trains were provided.

In any such country the question of feed for the animals is the limiting factor. If the country produces this, supplies can be transported an indefinite distance. If no feed is found growing there, in a few days the animals will "eat the packs off their backs," delivering nothing beyond. Therefore, the advance of the wagon road is necessary, over which many times as much per animal can be transported. This was accomplished on the Selkirk Range, so that by the end of December ample supplies had been placed at winter quarters on the west slope. After that the wintering was accomplished in comfort—in tents for much of the winter and later in cabins. With abundant supplies, temperatures of —40° F. were not severely felt; and doubtless the low temperatures which appear to be so threatening in the Klondike region will be endured in similar comfort by those who have supplies. A duck tent of single thickness could be made warm enough by a sheet iron box stove of ordinary size. In the Klondike, as elsewhere, it will probably be a problem of food rather than of temperatures. The papers made the same terrifying predictions about the Selkirk cold that are now being made about the Klondike cold. In the Portland Oregonian, which I received via Winnipeg while on the Selkirks, the statement was made that human life could not stand the intense cold of a winter in such a region. I read that paragraph in the dead of winter in my cabin on the Selkirks, in an upper room without a fire, and with my coat thrown off because of the excessive heat from the rooms below. There is no cold which cannot be comfortably met by the man who has ample supplies of food and moderate supplies of fuel and clothing, even if his shelter be very inferior. With such supplies, the cold weather in most cases will be found a tonic to the system. It is not a question of the cold or of the snows, but of transportation.

The construction of the Selkirk wagon road was continued westward during the winter, and the road was connected with the road from the west in December. Temperatures of —35° F. were experienced during this construction, but did not stop the work. Such a wagon road is made largely by clearing and grubbing, with moderate amounts of earthwork, and some rockwork at peculiarly difficult points. The small proportion of earthwork permits the work to go forward, the work other than earthwork being readily done in cold weather. For a road to be used chiefly for sledding, and where heavy snows are expected, the grubbing may be very much reduced.

The winter time, which is being pointed to as the obstacle to advancement into the Klondike region, is really just the time to make such an advance by the overland route, if that advance be properly organized and pushed. In transportation, as in logging, winter is the time for work. Sleds will carry much greater loads over the snow than wagons will take later on rough roads. The snow slides caused only temporary interruption on the Selkirk Range. The slides that went far below the wagon road (or "tote road," as it is termed) left in general only moderate amounts of snow on the road. The slides which came to rest near the road, leaving a great depth of snow on the road, did not permanently interrupt travel. The snow was soon packed hard enough for teaming to be done over it as usual. It is stated that east of the Chilkat Pass, the winter snowfall is only about three feet; the topography of the country is not such as to create many large slides.

On the Rockies and Selkirks there were a few gradients, adverse to the haul of twenty feet per hundred, the difficulties being massed where helpers could be used readily. The Chilkat Pass, altitude 3,500 feet, shows eleven miles on one slope and ten miles on the other, or more than sufficient sustaining ground to give reasonable gradients for a wagon road, without deviation of route.

In attempting a comparison of the Klondike overland route with the Selkirk transportation, we are at a disadvantage, owing to the variations in miners' estimates of distances. Approximately the route appears to be as follows:

| | |
|---|---|
| Dyea to head of navigation | 6 miles |
| Southwest slope of Chilkat Pass | 11 " |
| Northeast " " " " | 10 " |
| On Lake Linderman | 8 " |
| Portage | 1 " |
| On Lake Burnett | 26 " |
| Portage and Caribou River | 3 " |
| On Lake Tagish | 17 " |
| Portage to Marsh Lake | 3 " |
| On Marsh Lake | 24 " |
| On White Horse River to the rapids | 27 " |
| " " " " below the rapids | 30 " |
| On Lake Le Barge | 31 " |
| On Louis River | 62 " |
| By land to Fort Selkirk (at the junction of the Louis and Pelly Rivers, forming the Yukon River) | 200 " |
| Total to the Yukon | 459 " |

Thence down the Yukon and up its tributaries by boat from 100 to 150 miles, according to the location of the mine or claim. As ten or a dozen claims would take up a mile of river under the old regulations, and as there are several thousand men already holding claims, a statement as to how far a man may have to go to reach his journey's end is necessarily an elastic affair by 50 or 100 miles. The last 25 or 50 miles would probably be on land. (The 200 miles of land travel to Fort Selkirk is given by some miners; others appear to travel this distance by boat.)

The Klondike overland route thus includes three important stretches of land travel, namely, at the Chilkat Pass, at the portion before Fort Selkirk is reached, and at the terminus of the journey. The first two stretches are traveled by all, and are a matter for public improvement; the last stretch will probably be a matter for packhorse work by the individual miner. The public route, with the exception of the first two stretches of land travel, is one affording a natural road in winter of the best sort of sledding, on frozen lakes and rivers, with a few short places requiring improvement. The blockade of which we hear most is that of the Chilkat Pass, where great numbers of men en route appear to be lying idle, awaiting the few Indian packers who are available, and who are charging from fifteen to twenty-five cents per pound for packing the twenty-seven miles to Lake Linderman. Thence the route is by boats, poor affairs made on the ground out of green whip-sawed lumber. This mode of transportation was attempted on the Columbia River, east of the Selkirks, where the rapids were much less formidable than the Northwestern Rapids are reported to be; but even the deep mud of the wagon road in spring was preferred by all but half a dozen parties. Anyone who has felt the power of water in the rapids of a mountain stream is apt to have too much respect for it to select such a transportation route if any other can be found.

We hear but little of the blockade at the stretch of land travel before Fort Selkirk is reached. It may be more serious than the Chilkat blockade, being further from feed or horses and from the large body of packers, or this stretch may be covered by boat by most of the parties. Some of the writer's acquaintances in the West are arrang[illegible] both horses and dogs, the former at the Chu[illegible] latter in the later journey; the horses being killed for dog meat after the Chilkat transportation is completed. But dogs cannot be procured in sufficient numbers to meet the great demands of the situation. The probability is that the great mass of supplies will be transported to the Klondike region by winter transportation. Can this be done?

The difficulty of doing this by pack animals can be readily shown. Allowing only 20 pounds of feed per day per pony, and a load of 240 pounds per animal, in 12 days the pony has "eaten his load off his back," and must then be left to die, with no surplus delivered and nothing accomplished. This is just what happened in cases on the Selkirk Range, before the wagon road had been advanced; dead ponies were numerous along the trail. To place even 100 pounds per animal at the mines, a pack train must make the journey in less than seven days. The journey, even with the aid of water transportation, now takes over three times that length of time. In winter it has been known to take over 60 days.

On the other hand, assuming that a sled and team can take 3,000 pounds over a good sled road to the mines in about 20 days, we have about 800 pounds of the load consumed by the team and 2,200 pounds delivered. This is about a year's supply for a miner.

The weak point in the present situation appears to be the disorganized, individual character of the efforts to enter the country. At Dyea over 3,000 men are now said to be lying idle, awaiting packers. A tenth part of this number could construct a sled road across the Chilkat Pass in a few weeks, even if much rock work had to be done. No more provisions would be consumed by them than while lying idle. The Indian packers are too few to oppose effective resistance to such a construction; and the Pacific Coast Indian is not of the right make-up for a fight. There is a report that a company is being formed at Juneau to improve the transportation arrangements. A few weeks of work west of Fort Selkirk would probably secure a sled road at that stretch of land travel. For the rest of the distance, the winter will make the sled road. The eagerness to get to the mines this summer will probably prevent a proper combined effort until fall shows the blockaded parties the need of organized effort. Those who force their way in after August will reach the mining region poorly provided with supplies, worn out by their efforts to get in, and too late to prospect before snow. Those who go more deliberately and intelligently, after aiding in the construction of a sled road, will arrive in comparative comfort, better provided with supplies, with ample time in the winter to make a good general selection of country in which to seek a claim; and they will be on the ground before the arrivals by boat on the Yukon. If there be only three feet of annual snowfall in the Yukon country, as reported, there may be more wind than is generally experienced in regions of heavy snow, the latter being generally windless in winter. Continuous sledding, which the large travel will secure, will overcome this difficulty and keep the road open. The possibility of delivering supplies by vessels in the Yukon region part of the year is an obstacle to the construction of a good overland sled road, as is also the prospect of a railway route, both of these routes making the sled road a temporary affair.

The cost of a wagon road in mountain country, similar to the Selkirk Range, with wages, not including board, $1.75 per day, may be taken at $1,800 per mile maximum, with a rate as low as $100 per mile on fairly level easy stretches, and at locations about 150 miles from the base of supplies. If there be only 3,000 tons to be transported, and if only twenty cents per pound be saved by the construction of 250 miles of sled road, the economy of its construction can readily be calculated. For men en route with their supplies, a rate of $1.75 per day would be a good figure, as they would probably work for the cost of their subsistence, in order to save their own stores of food.

Sleds are readily made in the woods by an expert woodsman with ax and auger. I have had one made in a half day that would carry a ton. To handle 4,000 tons, including feed, several thousand horses would have to be shipped to Dyea, if the horses were to be sold at the mines, making no additional trips. With probably five round trips possible, a much smaller number would answer, depots of supplies of feed being established for the return trips.

Those who rely upon making an early entrance by the land route into the Klondike region after the streams are open for boating will probably make a mistake. The break-up in these upper tributaries of the Yukon will occur much later than in the lower Yukon, and vessels will probably reach Dawson City before the upper streams on the overland route have subsided from the freshets and have become navigable safely. In the late spring the ice will become rotten and an interval of cessation of transportation occur. The road will be neither sled road nor wagon road for a time under the melting snow and the spring rains. The late spring for the overland route must be the worst possible time, judging from experience elsewhere. The winter may be found the best possible time under proper organization and with proper effort.—Archibald A. Schenck, in the Railroad Gazette.

[Continued from SUPPLEMENT, No. 1130, page 18067.]

## EDWARD DRINKER COPE, NATURALIST.*

THE studies of Cope on those classes which had earliest attracted his attention were more nearly completed than for any others. Many years ago he had contemplated the publication of monographs of the amphibians and reptiles of North America and happily he had at last finished his work.

In 1889 his monograph of the "Batrachia of North America" was given to the world as a Bulletin of the United States National Museum (No. 34). It forms a goodly volume of 525 pages illustrated by 86† plates and 120 figures inserted in the text. No large country has a more elaborate and scientific exposition of the class than is given in this volume. A synopsis is furnished of all the families and genera wherever found, and detailed descriptions are supplied for all the groups and species represented in the zoological realm of North America; 31 genera and 107 species are recognized, and of these Cope had first made known about a quarter, 7 of the genera and 27 of the species having been described by himself. Shortly before his death, and during his last visit to Washington, he delivered to the National Museum the report on all the reptiles of North America which he had been long preparing. This was prepared on the model of his "Batrachia of North America," but will, of course, be a much larger work, inasmuch as there are nearly three times as many reptiles as Batrachians.‡ His last elaborate memoirs dealt with special anatomical features of the serpents and lizards, which he examined with the view of perfecting the system of those groups.

### IV.

In 1864 he became especially interested in the fresh water fishes of the United States, and then, as well as in succeeding years, published enumerations and descriptions of many species. His first papers in 1864 and 1865 were "On a Blind Silurid from Pennsylvania" and a "Partial Catalogue of the Cold Blooded Vertebrata of Michigan;" in 1868 he published "On the Distribution of Fresh Water Fishes in the Allegheny Region of Southwestern Virginia," and in 1869 appeared a "Synopsis of the Cyprinidæ of Pennsylvania." In addition to these, various minor papers were published, and in some of them marine forms were considered.

When in Europe Cope had purchased a large collection of skeletons of fishes from all parts of the world prepared by Prof. Joseph Hyrtl, of Vienna, one of the most skillful practical anatomists of the day. He had a number of other skeletons made to represent missing types. With these as a basis he proceeded to recast the classification of fishes. The first contribution to the subject was embodied in an introductory chapter of his "Contribution to the Ichthyology of the Lesser Antilles," published early in 1871.

The same chapter, with the same title, "Observations on the Systematic Relations of Fishes," but with some modifications and additions, was later published in the Proceedings of the American Association for the Advancement of Science for 1871. This was a notable paper and replete with original observations of value. It was not, however, up to the standard of his work on amphibians and reptiles. The subject, indeed, was too vast and only a superficial examination was made of special parts. It was not a classification based on the examination of the entire structure, but rather an exposition of the development of a few particular characters, which more experience subsequently convinced him were of less value than he had supposed. Nevertheless, in some respects the proposed classification was much in advance of those previously adopted, and useful hints were given for the further improvement of the system.

Later Cope followed up this attempt at the reformation of the ichthyological system with several others especially treating of extinct types. One of them, "On the Classification of the Extinct Fishes of the Lower Types," was published in the Proceedings of the American Association for 1877. The results of his studies were summarized, in 1889, in "A Synopsis of the Families of Vertebrata," and two years afterward (1891) with modifications, in an article "On the Non-actinopterygian Teleostomi." These results were very valuable and attention was for the first time directed to the importance and morphological significance of the skeletal fin structures of the ancient fishes long confounded under the name of Ganoids. Instead of this single order (or sub-class) of the old systematists, he named four superorders of the Teleostomi or true fishes, and recognized seven orders, including the old Ganoids after eliminating the Lepidosteids and Amiids, which were referred to the Actinopterygians. Only two of the seven orders are represented by existing forms—one (Cladistia) by the bichirs of Africa and the other (Chondrostei) by the sturgeons.

His work on the extinct fishes was incomparably better than any that had been done before in the United States. He far surpassed all his predecessors, not only by his knowledge of morphological details manifest in the extinct as well as living forms, but by

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

† The last plate is numbered 86, but five were canceled—80, 81, 82, 84 and 85.

‡ Cope's monograph of the reptiles will not include the tortoises, those having been left to Dr. G. Baur to monograph.

his keen philosophical instinct and taxonomic tact. But this philosophical instinct was sometimes at fault, and occasionally he indulged in the wildest speculations, for which he has, not unjustly, been taken to task. But even his blunders were the result of the facility of his mind in seizing and adapting the latest utterances of science.

One notorious case may be given. The great Russian embryologist, Kowalevsky, published a memoir sustaining the thesis that the Tunicates were members of the vertebrate phylum and that the larval stage of most of the species had the homological equivalent of the backbone of the true vertebrates. Cope foresaw the morphological consequences of this view and sought the vertebrates nearest the Tunicates. He settled upon some strange forms of the Silurian and Devonian times known as Pteraspids and Cephalaspids. They were the earliest known of vertebrates and therefore likely to be the most primitive in structure. Most of them had a shell-like encasement, composed of bone-like plates. He happened to find illustrations of the living Chelyosoma, a true Tunicate having a system of plate-like indurations of the integument, somewhat similar in appearance to those of some of the ancient fishes. It was assumed that this mere superficial similarity indicated genetic relationship. To those acquainted with the structure of Chelyosoma this approximation seemed strange indeed; its anatomy was known and the form is simply a well marked relation of the typical ascidiids, but highly specialized by the development of integumentary plate-like horny indurations. Histologically and otherwise they were very different from the plates of the extinct armored vertebrates. Cope's guess was simply the result of the tendency to jump at conclusions which he was constantly obliged to curb, and unfortunately he rushed into print before he had time to think. He soon reconsidered the case with calmer mind, and abandoned his hypothesis. Few men were ever more willing to reconsider evidence and retrace false steps than he.

In spite of errors of detail and somewhat hasty generalization the ichthyological labors of Cope were unusually valuable contributions to science, and the progress of ichthyology has been much accelerated, not only by these labors, but by the investigations they challenged.

V.

Cope's attention was early drawn to the mammals. His first published article (1863) was a description of a supposed new shrew found in New Hampshire, and in 1865 he described various cetaceans. In 1868 he began the collection and investigation of the fossil mammals of the Western territory, and thenceforward devoted the larger share of his attention to the description and restoration of the numerous new species which he from time to time brought to light. The previous investigators of the extinct mammals of America had almost exclusively confined themselves to descriptions and illustrations of the crania and dentition, but a new era was introduced when Marsh and Cope sent out exploring expeditions or themselves collected. No parts of skeleton were neglected; all were collected. Gradually the numerous bones from different parts of the skeleton were identified, and finally many of the beasts of old were resurrected into skeletons almost as complete as those just divested of muscles.

The discoveries resulting from such thorough work quite modified or even overturned old conceptions. It became evident that there was a great contrast between the development of the mammals and that of invertebrates, and even, though in a less degree, of fishes. It appeared that there was a much more rapid process of evolution for the mammals than for the lower classes. All the mammals of the oldest of the Tertiary periods were strange and very unlike those of recent times, and no descendants of even the same families lived to be the contemporaries of civilized man. The views of the founder of vertebrate paleontology were also to a considerable extent subverted. Cuvier taught that there was always a co-ordination between the various systems of the animal frame and that from the remains or impress of one part the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter facts. One such case is so remarkable because it originated with Cuvier and was indorsed by Huxley* that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given. Huxley himself protests against the too literal application of Cuvier's law and recalls Cuvier's own reserve:

"Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I cannot refrain from quoting his words.†

"But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.

"However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation. It enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by. It is a surer mark than all those of Zadig."

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the co-ordination of the "foot cleft" with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the "mind's eye," if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the lapsus. Yet every one will admit that the hog has the "foot cleft" as much as any ruminant, but the "form of the teeth" and the form of some vertebræ are quite different from those of the ruminants, and of course the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity.

I need scarcely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Unitatherid or a Menodontid.

I have given this quotation for two reasons: first, to indicate how the increase of our knowledge has revolutionized old conceptions; and second, to show how even the ablest of men may stumble.

Cope has been much criticised for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters, he covered more ground and did more work. He was also, it must be admitted, more hasty than some others, in that he availed himself of the more frequent means of publication he enjoyed.

The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.

He introduced many new families in the system and sought to improve the system by the comparison of all the elements of the skeleton. He came to the conclusion that the affinities of the ungulate quadrupeds was best expressed by the manner of articulation of the bones of the carpus and tarsus; he associated those having the "carpal and usually tarsal bones in linear series" in a great order which he called Taxeopoda, and contrasted them with the Proboscidea and typical Ungulata, which he named anew Diplarthra. In the Taxeopoda he gathered many extinct families and associated with them forms of the existing fauna known as the Hyracoidea, Daubentonioidea, Quadrumana and Anthropomorpha. I cannot altogether assent to this collocation, inasmuch as I think the common characteristics of the three groups last mentioned—especially the structure of the brain and the development of the posterior cornua of the ventricles as well as calcarine sulci—justify the old order Primates. Nevertheless an important character was first appreciated in the composition of the podial bones, and fresh insight was obtained into the relations of ancient types.

I can only name a few more of Cope's discoveries in this connection. One was the generalization of "trituberculy," or the original development of three tubercles to molar teeth, and that subsequent modifications of the corresponding teeth were based on this original plan. Another was the remarkable Phenacodus of the Eocene, which was considered to be nearly in the line of descent for the ungulates as well as the series culminating in man and which led him to the conception of the taxeopodous group.

The past history and genealogy of the camels and their relations were likewise elucidated. In the present epoch only two nearly related types exist separated by half the globe—the true camels of central and northern Asia and the llamas of the Peruvian Andes. Cope revealed numerous species from various Tertiary beds and showed that the type was originally richly developed in America.

VI.

Paleontology from more than one point of view may be divided into Invertebrate and Vertebrate. The subjects of the former are generally to be found in an approximately complete condition so far as the exterior is concerned, and early attracted the attention of investigators, often little familiar with recent zoology, and received names. The subjects of the latter—especially the higher types, as mammals, birds and reptiles—are rarely found, except in a fragmentary condition. Special knowledge of osteology, even to its minutest details, is requisite to successfully deal with such remains. Consequently the fossil vertebrates of the United States were neglected and left to the few who had cultivated the requisite knowledge to deal with them.

Another reason existed for the tardy attention to Vertebrate paleontology, which continued till nearly the last quarter of our present century in the United States. No deposits containing many fossil vertebrate remains had become known in the East. Zoologists interested in the past and in the genealogy of existing forms lamented the poverty of the United States, which contrasted with the richness of some parts of Europe. It was even thought that there was no hope of finding here such trophies of the past as the beds of the Paris Basin or those of Grecian Pikermi had yielded to European paleontologists. But all this was to be changed. Rumor had long before hinted that numerous skeletal remains could be found in certain parts of the wild West, but the information was very vague. Enough was known, however, to induce Prof. Marsh to visit certain deposits he had heard of. In 1870 he explored an Eocene lake basin in Wyoming, drained by the Green River, the main tributary of the Colorado, and therein found numerous bones belonging to almost all parts of the skeleton of some remarkable gigantic mammals which he called Dinocerata. The results of this exploration interested Cope in the highest degree. He visited the same region in 1872, and thenceforth his attention to the Vertebrate paleontology of the Western States and Territories was never interrupted. An intense rivalry arose between Prof. Marsh and himself which in time, it must be confessed, became very bitter. Nevertheless, as in most quarrels respecting facts, investigations were provoked by mutual recriminations which resulted in a more speedy accumulation of data and a more critical examination of those data than would have been likely under less perturbed conditions. Most of those data relate to morphological and anatomical considerations, and therefore belong rather to mammalogy and herpetology than to geology.

The relations of the ancient forms to each other in point of time; to those of other lands, and to those whose remains were embedded in other rocks had necessarily to be investigated. The earliest conclusions of Cope were brought together and published in 1879 in a memoir on "The Relations of the Horizons of Extinct Vertebrata of Europe and North America."* He attempted therein to synchronize, or, rather, homotaxially correlate the various ancient fauna of North America and "West Europe" from the "Primordial" to the "Pliocene." Naturally the greater part of the memoir was devoted to the consideration of the Tertiary divisions; of these he admitted for the American form six primary divisions, and four of these were dichotomously subdivided for the time. Of the primary divisions three were referred to the Eocene, one (White River) to the Oligocene, one (Loup Fork) to the Miocene, and one to the Pliocene. The exposition thus made represents views not very different from those now held, although, of course, modifications in details have since been necessary.

The evolution of the various animal, and especially mammalian types, was also continually the subject of Cope's researches, and he attempted to trace the passage from those of the most ancient periods to those of later ones.

(To be continued.)

## ADDRESS BY SIR JOHN EVANS,

K.C.B., D.C.L., LL.D., Sc.D., Treas. R.S., V.P.S.A., For. Sec. G.S.; Correspondant de l'Institut de France, etc.; President of the British Association for the Advancement of Science.†

ONCE more has the Dominion of Canada invited the British Association for the Advancement of Science to hold one of the annual meetings of its members within the Canadian territory; and for a second time has the association had the honor and pleasure of accepting the proffered hospitality.

In doing so, the association has felt that if by any possibility the scientific welfare of a locality is promoted by its being the scene of such a meeting, the claims should be fully recognized of those who, though not dwelling in the British Isles, are still inhabitants of that Greater Britain whose prosperity is so intimately connected with the fortunes of the mother country.

Here, especially, as loyal subjects of one beloved sovereign, the sixtieth year of whose beneficent reign has just been celebrated with equal rejoicing in all parts of her empire; as speaking the same tongue, and as in most instances connected by the ties of one common parentage, we are bound together in all that can promote our common interests.

There is, in all probability, nothing that will tend more to advance those interests than the diffusion of science in all parts of the British Empire, and it is toward this end that the aspirations of the British Association are ever directed, even if in many instances the aim may not be attained.

We are, as already mentioned, indebted to Canada for previous hospitality, but we must also remember that, since the time when we last assembled on this side of the Atlantic, the Dominion has provided the association with a president, Sir William Dawson, whose name is alike well known in Britain and America, and whose reputation is indeed world wide. We rejoice that we have still among us the pioneer of American geology, who among other discoveries first made us acquainted with the "Air Breathers of the Coal," the terrestrial or more properly arboreal saurians of the New Brunswick and Nova Scotia coal measures.

On our last visit to Canada, in 1884, our place of assembly was Montreal, a city which is justly proud of her McGill University; to-day we meet within the buildings of another of the universities of this vast Dominion—and in a city, the absolute fitness of which for such a purpose must have been foreseen by the native Indian tribes when they gave to a small aggregation of huts upon this spot the name of Toronto—"the place of meetings."

Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister association of the United States of America—still mourning the loss of her illustrious president, Professor Cope—and some other learned societies, have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions, and aiding us by interchange of thought. To such a meeting the term "international" seems almost misapplied. It may rather be described as a family gathering, in which our relatives more or less distant in blood, but still intimately connected with us by language, literature and habits of thought, have spontaneously arranged to take part.

The domain of science is no doubt one in which the various nations of the civilized world meet upon equal terms and for which no other passport is required than some evidence of having striven toward the advancement of natural knowledge. Here, on the frontier between the two great English speaking nations of the world, who is there that does not inwardly feel that anything which conduces to an intimacy between the representatives of two countries, both of them actively engaged in the pursuit of science, may also, through such an intimacy, react on the affairs of daily life, and aid in preserving those cordial relations that have now for so many years existed between the great American republic and the British Islands, with which her early foundations are indissolubly connected? The present year has witnessed an interchange of courtesies which has excited the warmest feelings of approbation on both sides of the Atlantic. I mean the return to its proper custodians of one of the most interesting of the relics of the Pilgrim Fathers, the log of the Mayflower. May this return, trifling in itself, be of happy augury as testifying to the feelings of mutual regard

* Huxley, "Introduction to the Classification of Animals," 1869, in first chapter "On Classification in General."

† Ossemens fossiles, ed 4me, tome Ier, p. 184.

* Bull. U. S. Survey Terr., v, 33-54.

† Delivered at Toronto, August 18, 1897.

and esteem which animate the hearts both of the donors and of the recipients!

At our meeting in Montreal the president was an investigator who had already attained to a foremost place in the domains of physics and mathematics, Lord Rayleigh. In his address he dealt mainly with topics, such as light, heat, sound, and electricity, on which he is one of our principal authorities. His name and that of his fellow worker, Professor Ramsay, are now and will in all future ages be associated with the discovery of the new element, argon. Of the ingenious methods by which that discovery was made, and the existence of argon established, this is not the place to speak. One can only hope that the element will not always continue to justify its name by its inertness.

The claims of such a leader in physical science as Lord Rayleigh to occupy the presidential chair are self-evident, but possibly those of his successor on this side of the Atlantic are not so immediately apparent. I cannot for a moment pretend to place myself on the same purely scientific level as my distinguished friend and for many years colleague Lord Rayleigh, and my claims, such as they are, seem to me to rest on entirely different grounds.

Whatever little I may have indirectly been able to do in assisting to promote the advancement of science, my principal efforts have now for many years been directed toward attempting to forge those links in the history of the world, and especially of humanity, that connect the past with the present, and toward tracing that course of evolution which plays as important a part in the physical and moral development of man as it does in that of the animal and vegetable creation.

It appears to me, therefore, that my election to this important post may, in the main, be regarded as a recognition by this association of the value of archæology as a science.

SIR JOHN EVANS.

Leaving all personal considerations out of question, I gladly hail this recognition, which is, indeed, in full accordance with the attitude already for many years adopted by the association toward anthropology, one of the most important branches of true archæology.

It is no doubt hard to define the exact limits which are to be assigned to archæology as a science and archæology as a branch of history and belles lettres. A distinction is frequently drawn between science on the one hand and knowledge or learning on the other; but translate the terms into Latin, and the distinction at once disappears. In illustration of this I need only cite Bacon's great work on the "Advancement of Learning," which was, with his own aid, translated into Latin under the title "De Augmentis Scientiarum."

It must, however, be acknowledged that a distinction does exist between archæology proper and what, for want of a better word, may be termed antiquarianism. It may be interesting to know the internal arrangements of a Dominican convent in the middle ages, to distinguish between the different mouldings characteristic of the principal styles of Gothic architecture; to determine whether an English coin bearing the name of Henry was struck under Henry II, Richard, John, or Henry III, or to decide whether some given edifice was erected in Roman, Saxon, or Norman times. But the power to do this, though involving no small degree of detailed knowledge and some acquaintance with scientific methods, can hardly entitle its possessors to be enrolled among the votaries of science.

A familiarity with all the details of Greek and Roman mythology and culture must be regarded as a literary rather than a scientific qualification; and yet when among the records of classical times we come upon traces of manners and customs which have survived for generations, and which seem to throw some rays of light upon the dim past, when history and writing were unknown, we are, I think, approaching the boundaries of scientific archæology.

Every reader of Virgil knows that the Greeks were not merely orators, but that with a pair of compasses they could describe the movements of the heavens and fix the rising of the stars; but when by modern astronomy we can determine the heliacal rising of some well-known star, with which the worship in some given ancient temple is known to have been connected, and can fix its position on the horizon at some particular spot, say three thousand years ago, and then find that the axis of the temple is directed exactly toward that spot, we have some trustworthy scientific evidence that the temple in question must have been erected at a date approximately 1,100 years B. C. If on or close to the same site we find that more than one temple was erected, each having a different orientation, these variations, following as they may fairly be presumed to do the changing position of the rising of the dominant star, will also afford a guide as to the chronological order of the different foundations. The researches of Mr. Penrose seem to show that in certain Greek temples, of which the date of foundation is known from history, the actual orientation corresponds with that theoretically deduced from astronomical data.

Sir J. Norman Lockyer has shown that what holds good for Greek temples applies to many of far earlier date in Egypt, though up to the present time hardly a sufficient number of accurate observations have been made to justify us in foreseeing all the instructive results that may be expected to arise from astronomy coming to the aid of archæology.

The intimate connection of archæology with other sciences is in no case so evident as with respect to geology, for when considering subjects such as those I shall presently discuss, it is almost impossible to say where the one science ends and the other begins.

By the application of geological methods many archæological questions relating even to subjects on the borders of the historical period have been satisfactorily solved. A careful examination of the limits of the area over which its smaller coins are found has led to the position of many an ancient Greek city being accurately ascertained; while in England it has only been by treating the coins of the ancient Britons, belonging to a period before the Roman occupation, as if they were actual fossils, that the territories under the dominion of the various kings and princes who struck them have been approximately determined. In arranging the chronological sequence of these coins, the evolution of their types—a process almost as remarkable, and certainly as well defined, as any to be found in nature—has served as an efficient guide. I may venture to add that the results obtained from the study of the morphology of this series of coins were published ten years before the appearance of Darwin's great work on the "Origin of Species."

When we come to the consideration of the relics of the early iron and bronze ages, the aid of chemistry has of necessity to be invoked. By its means we are able to determine whether the iron of a tool or weapon is of meteoritic or volcanic origin, or has been reduced from iron ore, in which case considerable knowledge of metallurgy would be involved on the part of those who made it. With bronze antiquities the nature and extent of the alloys combined with the copper may throw light not only on their chronological position, but on the sources whence the copper, tin, and other metals of which they consist were originally derived. I am not aware of there being sufficient differences in the analyses of the native copper from different localities in the region in which we are assembled for Canadian archæologists to fix the sources from which the metal was obtained which was used in the manufacture of the ancient tools and weapons of copper that are occasionally discovered in this part of the globe.

Like chemistry, mineralogy and petrology may be called to the assistance of archæology in determining the nature and source of the rocks of which ancient stone implements are made; and, thanks to researches of the followers of those sciences, the old view that all such implements formed of jade and found in Europe must of necessity have been fashioned from material imported from Asia can no longer be maintained. In one respect the archæologist differs in opinion from the mineralogist—namely, as to the propriety of chipping off fragments from perfect and highly finished specimens for the purpose of submitting them to microscopic examination.

I have hitherto been speaking of the aid that other sciences can afford to archæology when dealing with questions that come almost, if not quite, within the fringe of history, and belong to times when the surface of our earth presented much the same configuration as regards the distribution of land and water, and hill and valley, as it does at present, and when, in all probability, the climate was much the same as it now is. When, however, we come to discuss that remote age in which we find the earliest traces that are at present known of man's appearance upon earth, the aid of geology and palæontology becomes absolutely imperative.

The changes in the surface configuration and in the extent of the land, especially in a country like Britain, as well as the modifications of the fauna and flora since those days, have been such that the archæologist pure and simple is incompetent to deal with them, and he must either himself undertake the study of these other sciences or call experts in them to his assistance. The evidence that man had already appeared upon the earth is afforded by stone implements wrought by his hands, and it falls strictly within the province of the archæologist to judge whether given specimens were so wrought or not; it rests with the geologist to determine their stratigraphical or chronological position, while the palæontologist can pronounce upon the age and character of the associated fauna and flora.

If left to himself, the archæologist seems too prone to build up theories founded upon form alone, irrespective of geological conditions. The geologist, unaccustomed to archæological details, may readily fail to see the difference between the results of the operations of nature and those of art, and may be liable to trace the effects of man's handiwork in the chipping, bruising, and wearing which in all ages result from natural forces; but the united labors of the two, checked by those of the palæontologist, cannot do otherwise than lead toward sound conclusions.

It will perhaps be expected of me that I should on the present occasion bring under review the state of our present knowledge with regard to the antiquity of man; and probably no fitter place could be found for the discussion of such a topic than the adopted home of my venerated friend, the late Sir Daniel Wilson, who first introduced the word "prehistoric" into the English language.

Some among us may be able to call to mind the excitement, not only among men of science but among the general public, when, in 1859, the discoveries of M. Boucher de Perthes and Dr. Rigollot in the gravels of the valley of the Somme, at Abbeville and Amiens, were confirmed by the investigations of the late Sir Joseph Prestwich, myself, and others, and the co-existence of man with the extinct animals of the quaternary fauna, such as the mammoth and woolly haired rhinoceros, was first virtually established. It was at the same time pointed out that these relics belonged to a far earlier date than the ordinary stone weapons found upon the surface, which usually showed signs of grinding or polishing, and that in fact there were two stone ages in Britain. To these the terms neolithic and palæolithic were subsequently applied by Sir John Lubbock.

The excitement was not less when, at the meeting of this association at Aberdeen in the autumn of that year, Sir Charles Lyell, in the presence of the Prince Consort, called attention to the discoveries in the valley of the Somme, the site of which he had himself visited, and to the vast lapse of time indicated by the position of the implements in drift deposits a hundred feet above the existing river.

The conclusions forced upon those who examined the facts on the spot did not receive immediate acceptance by all who were interested in geology and archæology, and fierce were the controversies on the subject that were carried on both in the newspapers and before various learned societies.

It is at the same time instructive and amusing to look back on the discussions of those days. While one class of objectors accounted for the configuration of the flint implements from the gravels by some unknown chemical agency, by the violent and continued gyratory action of water, by fracture resulting from pressure, by rapid cooling when hot or by rapid heating when cold, or even regarded them as aberrant forms of fossil fishes, there were others who, when compelled to acknowledge that the implements were the work of men's hands, attempted to impugn and set aside the evidence as to the circumstances under which they had been discovered. In doing this they adopted the view that the worked flints had either been introduced into the containing beds at a comparatively recent date, or if they actually formed constituent parts of the gravel, then that this was a mere modern alluvium resulting from floods at no very remote period.

In the course of a few years the main stream of scientific thought left this controversy behind, though a tendency to cut down the lapse of time necessary for all the changes that have taken place in the configuration of the surface of the earth and in the character of its occupants since the time of the palæolithic gravels still survives in the inmost recesses of the hearts of not a few observers.

(To be continued.)

## PRESERVATION OF FRESH GRAPES AND SEED POTATOES IN ITALY.

CONSUL-GENERAL JONES writes from Rome, June 24, 1897:

A recent bulletin of the School of Agriculture of Scandicci, Italy, describes experiments made by Prof. Marchi for the keeping of grapes fresh during the winter. A certain quantity of grapes (comprising different qualities) was hung up in a cool and dry place, all damaged berries having been previously removed; a second lot was packed in dry, pulverized peat in wooden boxes. At the end of four months the grapes that had been hung up had become decayed and had dropped off; on the other hand, those that had been packed in the boxes were found to be in fine condition. This is, therefore, a simple and economical method. Another one consists in gathering the bunches with a good bit of stem attached and immersing their tips in bottles containing water and pulverized charcoal. Experiments were also made for preserving seed potatoes by using corn shucks, sawdust, peat, and very dry sand. The three first mentioned substances gave the best results, while the sand proved a failure.

## ALPINIA NUTANS.

OUR illustration shows a plant of a genus not common in English gardens, but frequently met with on the Continent. The Alpinias (Globba) form a rather large genus of stove, herbaceous perennials of much beauty of flower and elegance of habit. The flowers are disposed in terminal spikes, those of A. nutans being pink colored, of agreeable fragrance, and the spike drooping. The leaves are lanceolate, smooth, entire, and sheathed at the base. The roots are fleshy, like most Zingiberaceæ, and have much the taste and aroma of ginger. Alpinias require a high temperature, rich soil, and plenty of root space. Therefore, they succeed better when planted in borders or large tubs, and frequent applications of liquid manure and rich mulches are essential to vigorous growth, and without this, flowering is poor or altogether repressed. Soon after flowering the leaves assume a yellow tinge, and water should be withheld, but much drying off must not be practiced. They must not be exposed to less heat when at rest than at other times. The flowers appear in May. We are indebted to the kindness of the Marquise Strozza, Florence, who sent us a photograph, for the opportunity of furnishing our readers with a figure of Alpinia nutans.—Gardeners' Chronicle.

ALPINIA NUTANS.

Color of flowers, pink. Height to which a plant will grow, 12 feet.

**The attention** of the German and French governments has recently been directed, says the National Druggist, to a brand of cigarettes that has become a fashionable favorite under the name "Bouts dorés," or "Gilt ends." The end intended to go between the lips is covered with a metallic leaf which is claimed to be gold, but which analysis shows to be an imitation of gold attached to the paper by lead chromate. In another form, called "Bouts Argentés" (silvered ends), a false silver leaf is attached to the paper by white lead.

[Continued from SUPPLEMENT, No. 1130, page 18070.]

## THE SCIENCE OF HUMANITY.

By W. J. McGEE.*

### OF THE SCIENCE OF ANIMAL MAN.

THE domain of anthropology is vast, and, partly by reason of its very magnitude, is sometimes deemed indefinite; yet, in the light of the history of science in general, its limits and subdivisions may easily be outlined.

History and analogy combine to show that the study of man began with wounds and diseases and grew into surgery and medicine, which were at first thaumaturgic, but gradually became rational or scientific; and in this way definite knowledge of the human body gradually accumulated and anatomy and physiology, with various ancillary sciences and subsciences, took form and function. Meantime the organs of the human body were compared and identified with those of beasts and birds (which were long the better known), and comparative anatomy was established; but it was not until observation and generalization were fertilized by scientific zoology that the study of structures in their functional aspect took shape in morphology. Under the influence of humanitarian therapy and the unprecedented stimulus of the Darwinian doctrine of development, the investigations of the last century, and particularly the last quarter century, have extended from structures to functions, and these, through the fruitful science of embryology, to human ontogeny and phylogeny—to the individual and generic evolution of man considered as an animate organism. Accordingly, there are several branches of science which deal alike with the human organism and the various other animal and even vegetal organisms of the great vital series in which man is usually, though not invariably, considered the culminating and crowning form. Here anthropology and biology blend; but it is convenient and desirable to distinguish that division of the science of man which deals with the organic features of the order Bimana, and this science or subscience is frequently called somatology. Although the oldest and the simplest among the divisions of the anthropologic sciences, somatology comprises various special branches of knowledge commonly classed as sciences, including pathology, physiology, etiology, etc., representing the specific methods and purposes of particular classes of investigators.

The early books and maps of civilized nations show that explorers and pioneers were profoundly impressed by the faraway peoples encountered in their wanderings. There are not only accounts but pictures of headless men with faces in their chests, of Cyclops with single eyes set skyward, and of other impossible monstrosities in human semblance; even since zoology became fairly definite, accounts of ten-foot giants in Patagonia and three-foot pygmies in central Africa and other lands remote or hidden have gained currency and credence. As exploration continued, the unconscionable extravagances of vision were gradually corrected, and the explorers came to see alien races in proper form and something like proper stature; yet the interest in the stranger peoples remained unabated and led to systematic observation and record. Borrowing methods from biology, the observers or their interpreters sought to classify the men of different continents and provinces and islands by somatic characters—by stature, color of skin, color and texture of hair, color and attitude of eyes, form of feature, form and size of skull, peculiarities of long bones, etc.; and, as the researches became definite and fruitful, they were combined in a science of races called ethnology. This science has much in common with biology and is a direct outgrowth from the group of sciences pertaining to the human body combined under the term somatology.

After centuries of unscientific and unsuccessful search for the seat of the soul through baseless deduction and blind introspection, certain thinkers began to profit by contemporary researches in anatomy and physiology; and as eye and mind were trained—even as the eye and mind of the traveler were trained not to make monstrosities out of unfamiliar races—the form and function of the nervous system were gradually recognized, and the dominance of the brain was finally established. Only within a generation or two has the brain been investigated in a scientific way and with due appreciation of the importance of that marvelous ganglion preformed in the articulates, enriched throughout the long line of vertebrates, and perfected in the ultimate mammalian form of the genus Homo; yet during the present quarter century the research has been organized in a science already cultivated in many lands and taught in most of the leading universities. The earlier promoters of this science approached the subject haltingly from the speculative or deductive side, and perhaps for this reason the science is named not so much from the organ itself as from its product, psychology. This modern science is not to be confounded with the fantastic notions sometimes foisted under the same designation which do little more than obstruct progress; the parent stock of the science was indeed speculative—as is most knowledge in the beginning—but so soon as the graft of somatology was affixed it became fruitful. It is to be noted that while somatology is essentially biotic, and ethnology is biotic in so far as it rests on bodily features, psychology pushes beyond the domain of biology proper, partly in that the human brain owes its perfection of development to the essentially human attributes, partly in that the science, as commonly defined, embraces both brain and mind, both organ and product.

So there are three well-established and widely recognized sciences whose object-matter is man considered as an organism; by some students—especially those of past decades—they are held to constitute the whole of anthropology; by others they are combined as physical anthropology and regarded as including only the animal side of man, but excluding nearly the whole of the essentially human side—nearly, but not quite the whole, since the field of psychology is common ground. This is the view of several modern anthropologists, and is that held in this writing.

### OF THE POTENCY OF DEVICES.

Passing from that portion of the domain of anthropology which deals with man as an animate genus, there is found another and still broader portion occupied by that which man does as a sentient, volitient and intelligent being. It is true that this portion of the domain is less definite than the other, yet, in the light of intellectual progress, its limits and subdivisions also may be outlined, albeit in some measure provisionally.

The early explorers who came home laden with travelers' tales sometimes brought also more tangible cargo in the form of strange wares; and so the handiwork of the world gradually came under the observation of students, and in time museums were built partly to accommodate the constantly increasing collections of primitive and alien arts. Meantime observant persons in many lands were attracted by relics of archaic culture in the form of implements, weapons, ornaments, apparel and habitations, as well as burial places sometimes containing the bones of the ancient artisans; and these, too, were collected and museums were built to accommodate them in connection with the artificial material gathered among the living peoples of distant lands. As collectors and collections multiplied, the work was organized; and, although the initial stimulus came from observation in remote countries, the interest grew inward—as is the way of advancing knowledge—and the local research for the rare relics of past ages was the first to receive name and character as the science of archæology. As observations multiplied, resemblances were found between the culture products of remote times and remote places. The arts of primitive peoples were found to vary in a manner corresponding more or less closely to race, and thereby ethnic research gained new impetus and served in turn to guide research in the prehistoric; so archæology and ethnology became mutually helpful and grew apace and came to be intimately associated in most minds, despite the fact that the one is concerned primarily with what man is, the other with what man does; and in some circles these branches of inquiry came to be regarded as constituting the whole of anthropology.

At first the products of ancient and alien handiwork were accepted at their token value, much like the chemic elements before Avogadro, the planetary movements before Newton, our sun and others before the doctrine of the persistence of motion, the organic species before Darwin; but within a generation or two it has come to be realized that they possess an innate value as exponents of intellectual activity—as medals of human creation collectively attesting the birth and growth of discovery and invention, design and motive, and all other human faculties. Perhaps the time has not come for defining this stage in the progress of anthropology; it may be that the transition is not yet complete, or that the relations are too complex for easy grasp; yet it seems clear that when the anthropologist first saw in the implement of shell or stone an index to the mental operations of the implement maker hardly less definite than the written page to the thought of the writer, the science of man rose to a higher plane with a bound comparable to those marking great epochs in the development of the other sciences.

* Vice-presidential address before Section H of the American Association for the Advancement of Science, delivered at Detroit, August 9, 1897.

Now in science each advance gives a new standpoint from which a broader view may be gained; and with the recognition of what may be called the dynamic aspect of artificial objects, the way was prepared for further progress. It was soon perceived that the simplest devices are supplements to or substitutes for bodily organs—that the knife of shell or tooth or stone is a supplement to teeth and nails, that the hammer stone multiplies the efficiency of blows, and that the missile is equivalent to an indefinite prolongation of reach; and accordingly it was realized that, in so far as he is a maker and user of implements and weapons, even the lowest savage rises above the plane of purely animal life. It was next perceived that even the simplest devices react on the organisms in various ways. The substitution of the shell knife for nails and teeth diminishes the exercise, and hence the vigor of these organs, and removes them from the category of characters subject to development through the survival of the fittest in the strife for existence, so that in so far as he employs devices in lieu of organs the savage passes beyond the realm of organic development by natural selection; at the same time the exercise of making and using artificial devices in lieu of natural organs tends to develop distinctively intellectual or cerebral characters; so that the effect of competition in the use of devices is not only to remove man from the realm of the biotic, but to set him on a definite course of development in a new realm—the realm of the artificial or essentially human. As the view of the artificial continued to broaden, it was perceived that while the simpler devices may appertain to individuals, they are not an integral part of the individual like the organs which they supplement, but may and do pass from hand to hand and from group to group; also that the use of a device by one person prompts others to acquire and use similar devices, which they are able to do through mere exercise of volition, so that each discovery or invention is at once the germ of a line of devices and a stimulus to intellectual power; and thus it was recognized that there is a strong communal tendency in the realm of the artificial, that the tendency of the development of devices is toward interchange and co-operation, yet ever of such sort as to augment intellectual power and elevate the human above the subhuman.

In the light of the dynamic interpretation of devices it is easy to perceive the trend of superorganic succession, or development of the artificial, and to contrast it with the course of biotic evolution; the substance or substratum of the latter is living matter, that of the former any matter, living or dead, with which man chooses to deal. The mode of this is slow elimination of the unfit and unpremeditated survival of the fit, the method of that is immediate imitation and designed improvement of the ingenious; the tendency of biotic evolution is toward organic differentiation, that of artificial development mainly toward organic persistence, with endless multiplication and integration of devices. The effect of the one is individual or egoistic, that of the other communal and altruistic. With the recognition of the dynamic and successional aspects of artificial devices, anthropology gained a new significance; for to its objects-matter in the form of the human body and human races and the human brain there was added the whole series of artificial devices and the exceeding potent intellectual activities which these devices represent, and this addition is the basis of what is here styled the Science of Humanity.*

### OF THE ACTIVITIES OF MAN.

When artificial devices were interpreted in terms of activities, a new classification of human handiwork arose. At the same time the activities themselves became objects of research, which soon passed beyond the collections, and extended to the multifarious material devices in daily use among living peoples in the various stages of civilization from savagery to enlightenment; still later the research was extended to the intellectual or non-material devices which pre-eminently distinguish mankind, such as law, letters, and learning, in their numberless aspects. The study of the activities is now sufficiently advanced to indicate, at least provisionally, their relations among each other and to the merely organic processes; they may be arranged in the inverse order of their affinity with the vital.

1. The primary activities of mankind are connected with more or less spontaneous sensations of pleasurable character. They arise and expand in fairly definite order; among known primitive peoples they appeal chiefly to the senses, and among more advanced peoples they appeal largely to the emotions and the purely intellectual faculties; they root in sports, games, and decorations, and mature in the fine arts of painting, sculpture, the drama, poesy, and music, i. e., they constitute the esthetics. The artificial devices growing out of these activities go far toward filling those museums of the world devoted to archaic and ethnic material; and nearly a third part of current anthropologic literature is devoted to this class of objects and the activities which they represent. These activities and activital products form the object-matter of a broad and fruitful field of inquiry known of late as esthetology.

2. Intimately connected with the primary activities, and also originating in spontaneous vital processes, though becoming dominant only by organization through exercise and volition, there are other activities tending toward the maintenance of physical welfare. From a simple beginning in occupations akin to those of the beasts, they arise and expand with each step in cultural advancement from savagery to enlightenment; at first confined to food getting, they extend also to the making of apparel, the building of habitations, and eventually to the supply of intellectual demands, i. e., they constitute the industries of common parlance. The material devices growing out of the industrial activities have enriched anthropologic museums almost equally with those growing out of esthetic activities; and probably a fourth part of the current literature of anthropology is devoted to them and the activities by which they are produced. Together they form the object-matter of a broad and rich science commonly called technology.

It is to be noted that the greater part of the material investigated by the archeologist pertains also to the fields of esthetology and technology, though these are far broader in that they extend not only to a greater variety of activital products, but to the activities themselves. It may also be noted that both esthetics and industries, originating as they do in vital processes, are primarily individual, though they become collective partly through combination with higher activities; while the higher activities of the series are primarily collective. It is noteworthy, too, that the two lower classes of essentially human activities rest on a material basis and are represented primarily by material devices, while the activities of higher planes rise above the material in their essential character and are only incidentally represented by material devices.

3. The activities of the third class are connected with collective relations; and since they grow out of consanguinity or family relation they may be said to have a biotic germ. In general, the products of these activities originate as customs which grade into regulations and later into laws, and are perpetuated in tribal, national, and other institutions. The activities and their products are most intimately connected with and indeed form the chief basis of cultural progress. In the first culture stage, corresponding to what is commonly called savagery, the collective or social relation is based on kinship traced in the maternal line; in the stage commonly called barbarism, social relation rests on kinship traced through the paternal line—these stages forming tribal society. In the third stage the social organization passes from patriarchy through feudalism or an equivalent intermediate condition not yet formulated to that stage of individual property right in lands and goods which is commonly called civilization; and men are now passing into the stage characterized by intellectual property right which is commonly called enlightenment—the organization in the last two stages being essentially nonconsanguineal and constituting what is sometimes called national society. The several activities and activital products belonging to this class form the object-matter of a fecund science commonly called sociology—though the day of final agreement concerning the definition of the term is not yet.

4. In some measure the activities of the fourth class are an outgrowth of those of the third, since they are essentially superorganic and may be regarded as a means of establishing and maintaining relation; they comprise expression, pantomimic, oral, and graphic. Like the other activities, they arise and expand in a certain order; beginning with what is somewhat incongruously called gesture speech and with rudely articulate language, they mature in oratory and literature; and it is significant that the lines of development, so far as ascertained, run counter to those of biotic evolution, in that they are almost wholly convergent instead of divergent—so that these activities pertain, in every essential respect, to the superorganic realm of humanity. The principal activities are speech and writing; the tangible products are legend and literature—but the rich and ever growing content of these products is knowledge. The activities of expression and their products are commonly combined as the object-matter of another science frequently called philology—though in this case, too, there is diversity in definition and also in designation.

5. There remains a class of elusive and Protean yet immeasurably potent activities which come so near the Ego and are so hard to grasp and difficult to convey that it would seem almost hopeless to attempt to define them; they are the essentially intellectual activities which form the motive and burden of expression, and their products comprise beliefs, opinions, knowledge, wisdom, and all other purely intellectual possessions. These activities also arise in a definite order which is set forth summarily in earlier paragraphs; and by the most systematic thinkers they are considered to mature in science. The activities and their products are so obscure and so diverse that they have not been combined and named in the vernacular; yet they are by some students regarded as the object matter of one of the broadest of the special sciences, sophiology.*

So there are five classes of essentially human activities and activital products, each so rich in phenomena and principles and so far distinct from all other classes of things as to constitute an adequate basis for a science; they are the fine arts or esthetics, giving basis for esthetology; industries, forming the object-matter of technology; organizations or institutions, affording foundation for sociology; language and literature, with their science of philology; and the great plasma of knowledge, forming the ill-defined but all-important object-matter of sophiology. The five fields of research pertain primarily to man, and thus represent anthropology; yet even casual survey of their extent and character renders it evident that they pertain not at all to the animal side of man, but wholly to that side which intellectual man alone possesses—they are five sciences of humanity. Partly to distinguish them from the three distinct branches of knowledge concerning animal man, partly to fix their place in the body of knowledge, they have recently been combined under the term demonomy;† and this system of organized knowledge concerning wholly human things may fitly be designated the science of humanity.

As knowledge arises, it is applied to the promotion of happiness and welfare; this has been true of unorganized and unconsciously organized knowledge throughout the history of mankind, and is especially true of definitely organized knowledge, which thereby becomes applied science. Now knowledge concerning the human activities, even while unconscious or half conscious only, reacts upon and shapes the activities in such manner as constantly to increase their potency. Some of the ways in which the science of humanity stimulates and strengthens human activities are especially noteworthy.

1. While the great domain of anthropology is divisible into an animal side comprising three broad sciences and a human side made up of five still broader fields of research, other classifications are possible, and indeed of special utility when directed toward the practical application of the science to everyday affairs—for any assemblage of facts and relations may be classified in as many ways as there are purposes of classification. Experience shows that there is a peculiar advantage in classifying certain sciences by method of research rather than by the objects under investigation. Classified in this way, anthropology comprises (1) demography, i. e., the enumeration and description of men, activital products, etc.; (2) human geography (or anthropogeography), dealing with the geographic distribution of peoples and their products; (3) political economy, which is concerned primarily with applied social forces and their products; (4) history, which deals with the rise and fall of peoples and nations; and (5) philosophy, which scrutinizes materials and forces and sequences and seeks the causes of growth and decadence among human things. This classification traverses the same domain as the more general one, and serves to bring out the same facts and relations in somewhat different light, i. e., it is artificial rather than natural, technical rather than logical, subjective rather than objective, directive rather than creative; in brief, it expresses applied science rather than original research. For certain purposes it is desirable to combine the classifications and define special fields of inquiry by the coincidence between the two, as has recently been done happily by Giddings* and others; for the lines of thought represented in the two systems are strengthened by interaction—the one may be said to represent science and the other statecraft, and the two combine to advance mankind in knowledge and power.

2. At the outset the science of ethnology was closely affiliated with zoology, representing indeed little more than the concentration of biologic inquiry on a single order of animate organisms; but with the recognition of human activities, this science was raised to a new plane. The applications of demonomy in the classification of peoples and races are many and sweeping; already the natives of the western hemispheres are classified primarily by language and incidentally by other demotic features rather than by any or all biotic characters; already the great stages in human progress from savagery to enlightenment are seriated in terms of social organization in lieu of those of the bodily features with which the biologist is wont to deal; already the present day ethnologist gives first thought to the arts, industries, institutions, languages, and ideas of the races rather than to any or all of those individual features comprised in stature and form and color; already, indeed, the recognition of human activities and the course of human development has served to revolutionize the science of races no less completely than the older sciences were revolutionized by recognition of force and sequence; and just as the new chemistry, the new astronomy, and the new geology are distinguished, so it is meet to distinguish a new ethnology as a science of artificially organized groups rather than a science of mere upright animals.

3. With the rise of knowledge concerning activities, it was perceived that the primary function and eventual design of devices have always been to extend and increase human power, to enable man to control plants, subjugate animals, and to evade or utilize sun and storm, i. e., to make conquest of lower nature; accordingly it was recognized that, while the human characters reflect environment measurably, as the purely biotic characters do fully, it is the essential tendency and function of man to control, rather than to be controlled by, his environment. This human power did not spring into being full-fledged—indeed modern science knows no Minervan birth—but grew up slowly through the exercise and gradual strengthening of volition and the evolution of design; so primitive peoples are measurably controlled by their environment, while the control diminishes with successive culture stages up to that of enlightened man, who dominates by multifarious devices nearly every physical force. Examination of the successive stages in emancipation from environment brings to light many significant relations; thus it is found that when two or more primitive peoples of similar culture are subjected to similar conditions of environment their minds respond in similar ways, so that similar devices are discovered or invented; and recognition of this law of human progress has served to correct some of the most persistent misapprehensions by which anthropology, like all other sciences in their infancy, has been burdened. At the same time the recognition of progressively increasing conquest over the inorganic and the organic merely has served to define and dignify man's estate at the head of all nature.

4. Although certain human characters and characteristics were already under investigation, it can hardly be said that mankind in general came into the domain of scientific inquiry until the Darwinian doctrine of evolution was accepted; accordingly, anthropologists at first regarded man as subject to the law of organic development through the survival of the fittest. Then came the recognition of activital development in contradistinction from organic development; and the pendulum of opinion swung back so far that most modern anthropologists implicitly assumed the human generic form to be fixed and final, so far as organic development is concerned. It now appears that the pendulum swung too far; for a long series of highly significant yet but half appreciated observations indicate that, just as the human mind dominates the materials and forces of lower nature, so may it measurably control and fashion the organism in which it is embodied—already hygiene and gymnastics have improved unnumbered physiques and lengthened the days of thousands; already leading educational institutions maintain physical departments in which they undertake so to shape and strengthen the limbs and lungs and even the heart and bone of the matriculate that he may be graduated sound in body as strong in mind; yet these indications would seem only to point the way of progress and promise still better things in human development as later generations rise.

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**Acid-proof Cement.**—A coating which may be used to protect vessels from the action of the strongest acids is prepared by thoroughly mixing 2 p. of powdered asbestos, 1 p. of barium sulphate and 2 p. of soluble glass solution of 50° Be. gravity. For the feebler acids a glass solution of 30° Be. may be used.—Pharmaceutical Era.

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* The enlargement of the domain of anthropology as here set forth is regarded as marking the most important epoch in the development of this science, one of the most important in the history of science in general. Several investigators have contributed to it; perhaps the earliest, one of the most voluminous, and certainly the most original of these contributors is J. W. Powell, whose preliminary writings have appeared in a large number of addresses, official reports and minor papers, though his final results are not yet published.

* Sixteenth Annual Report of the Bureau of American Ethnology, 1897, page xviii.

† Fifteenth Annual Report of the Bureau of Ethnology, 1897, page xix.

* "The Principles of Sociology," 1896, page 49.

## ELECTRICAL NOTES.

**The sea-going** car on the Brighton and Rottingdean Electric Railway has resumed work.

**The installation** of a system of electric car lines at Vienna is being considered, and it is hoped that the service will commence on May 1, 1898.—Electrotechnische Rundschau.

**A blast** was fired by lightning at Rockland, Me., on June 28, killing one man and badly injuring two. Eight loaded holes were being connected for firing, when lightning struck the battery wire, thus prematurely firing the charges.

**A fifth** telephone connection is to be laid between Stuttgart and Goeppingen, Germany, as the four used hitherto are becoming insufficient for the growing service. The line is also to be extended to Geislingen.—Electrotechnische Rundschau.

**Recently Marconi's** experiments in telegraphy without wires were renewed at the Ministry of Marine, at Rome, before a number of journalists. Signor Marconi was to exhibit his apparatus before the King and Queen of Italy, and afterward proceeded to Spezia to transmit messages between different ships intercepted by other vessels.

**The latest** novelty in the way of buoys is an electric lamp supported by a buoy of 100 lb. weight, sufficient to bear up three men. It is provided with a secondary battery which preserves its charge for two months, and can supply current for lighting the 16 candle power lamp for six hours. The light is projected through a lens, and is visible a mile off.—Revue Industrielle.

**The new** Berlin Omnibus Company, says the Elektrotechnische Zeitschrift, intends to run a trial accumulator vehicle, and the order for its manufacture has already been placed. It is to be of the same size as an ordinary omnibus, with seats on the roof, and the cells will be placed both under the inside and outside seats. The cells will be charged after every two journeys (the length of the journeys is not mentioned). The company anticipates a considerable saving by the use of electrically propelled cars, as 10 horses daily are now required for an omnibus.

**An electrical** exhibition was opened in Riva, in the Tyrol, on May 27 last. Its main object is to draw the attention of industrial and agricultural circles in southern Tyrol to the manifold applications of electric power. Very little use is made of the waste water power in this district, though it is very abundant. The small market towns of Pergine and Roncegno have electric light, and also the health resort Areo, and Riva started a large water-driven generating station last year, but that is all. The most interesting feature of the exhibition, says the Wiener Zeitung, is the collection of light electrically-driven machines and labor-saving appliances shown by the Technological Trade Museum. A large number of the machines exhibited are shown in action.—The Electrician.

**At Capetown** considerable trouble was lately caused by an electric tramway line which had been laid in proximity to the submarine cable of the Eastern and South African Telegraph Company. This cable is looped around Table Bay in order to be out of the way of any anchors, and is connected to the wire on land at Adderley Road. For some 2,000 yards the trams run at a distance of about 900 yards from the cable. It was noticed as soon as the tramway was run that whenever a car started, a kick was given by the receiver. When sand or any other obstruction came between the wheels and the rails, the lines traced by the telegraph were uneven. All attempts to get rid of these troubles proved vain until a secondary cable was laid alongside the original one, for ten miles, connected on the land end to the receiver and on the further end to earth.—L'Electricien.

**Owing to** the intensity of the electric light used on board of men-of-war, men are frequently affected with eye complaints, which in some cases have led to total blindness. It is said that eyes in which the iris is not heavily charged with pigments—that is to say, gray and blue eyes—are more likely to be injuriously affected than brown eyes. These eye troubles are ascribed to two causes—viz., the intensity of the light and the action of the ultra-violet rays. Oculists recommend the interposition between the eye and any powerful light of a transparent substance which will intercept the ultra-violet rays, such as, for instance, uranium glass, which is yellow. The French naval authorities supply dark blue glasses for the use of those men who have to do with search lights, etc., and the cases in which injury has been caused to the eyes were those of men who had neglected to use these spectacles, which, however, do not appear to afford any protection against the ultra-violet rays.—Revue du Cercle Militaire.

**The question** of a proper or desirable unit for rating the efficiency of an electric plant is still open, says Power. If the pounds of coal per kilowatt hour be taken, the question immediately arises, "What kind of coal?" This objection cannot be met by substituting the calorific value of the coal and making the unit of comparison thermal units in coal per kilowatt hour, for a thousand heat units in one kind of coal are more available than in another, so that the question, "What kind of coal?" still stands. The money cost per kilowatt hour is not a correct basis for comparison of efficiencies, except among stations which are similarly situated with regard to cost of fuel. Professor William S. Aldrich proposes the kilowatts per million thermal units in the steam supplied to the whole station on a basis similar to that in vogue for pumping plants. This is an admirable system for specifying the efficiency of a pumping engine, and would be equally good for a steam dynamo, but, aside from the difficulty of determining accurately the heat units supplied to a station which will always define the heat unit as a scientific rather than a popular method, there is the fact that such a rating leaves out of account altogether one of the principal features of the station—the steam generating plant. Probably the most satisfactory popular expression of the efficiency of a station is the pound of coal per kilowatt hour, with a statement as to the class of coal used. In reporting a test, of course, all the data should be given, so that the reader may select that unit in which he is accustomed to think, and so that the reason for the result may be apparent.

## MISCELLANEOUS NOTES.

**The use** of paper for floorings has many advantages over that of wood. Paper, being a bad conductor of sound and heat, insures on the one hand privacy, and on the other a comfortable temperature in both summer and winter. To the foot a paper floor, though harder and more durable than wood, gives a similar impression to that produced by linoleum, and, being made in one piece, has no cracks to shelter all kinds of vermin.—Monatschrift für den Baudienst.

**Rubber mats** are now made for use in the bottom of porcelain bath tubs, the glassy surface of which is liable to cause painful accidents from slipping. The India Rubber World says that many a case of broken rib or serious bruise has been caused by a bather falling against the iron rim or sides of highly finished tubs. Cork mats have also been used, but are less desirable than rubber, as they chip off from frequent soaking, and pieces are apt to clog the pipes.

**Very good** porous bricks are made by the director of a mine in Libuschin, near Kladno, Bohemia, from a mixture of clay and bituminous slate. This latter is obtained in great quantities in the process of washing coal. The bricks made from this material are cheap, very strong and only about one-half as heavy as the ordinary stones. They are, moreover, bad conductors of sound and heat. At Vienna the price paid for them is $6.25 per thousand.—Monatschrift für den Oeffentlichen Baudienst.

**Dr. Schott,** of the Jena laboratory, has made a discovery by which he is enabled to raise the luminosity of the incandescent gas light by some 60 per cent. He noticed a considerable increase in the light given by a burner if the air struck the mantle at right angles instead of, as usual, almost parallel. He has devised a burner in which the air is fed into the flame so as to stream from the center against the mantle, the glass chimney being widened and the usual circular opening at the bottom closed.—Prometheus.

**A new** use of aluminum has been discovered in the manufacture of reproducers for talking machines. The reproducer is the apparatus which holds the vibrating diaphragm of glass. Heretofore the recorders and reproducers of talking machines have been made, as a rule, of hard rubber. For hard rubber, aluminum has been substituted, with what is regarded as much success. It is claimed that the blasting, blaring, or "chattering" as it is called in the trade, which is often noticeable in the performance of the talking machine, is almost completely absent when an aluminum reproducer is used.

**A patent** has recently been taken by the Society of Chemical Works at Mannheim, Germany, for a new process for the preparation of potassium or sodium thio-sulphate. The chloride of the metal is first treated in the usual way, a bicarbonate being obtained, then this product is acted on with sulphur dioxide in the presence of sulphur, water and sal ammoniac; the escaping carbon dioxide and the ammonia, taken up from the ammonium chloride, once more serve to prepare the carbonate from the chloride, so that the same material is used over and over again. The process is carried out in a series of retorts, some of which serve for the production of the bicarbonate, while in the others this is transformed into thio-sulphate.—Die Chemische Industrie.

**Messrs. Siemens & Halske,** of Berlin, have invented a process for purifying starch, which is based on the oxidation of the cellulose into oxycellulose by oxidizing agents and nascent chlorine, the latter being prepared by the action of hydrochloric acid on potassium permanganate. The starch is dissolved in cold water, then the manganate is brought to act on it, and this process is continued until the salt is no longer discolored. After this the starch must be bleached, for the manganese peroxide produced in the reaction has given the substance a brown color. This bleaching is readily effected by the addition of sulphurous acid, which removes the peroxide. The oxidation of the cellulose is effected by shaking the brown starch in a bath of dilute hydrochloric acid. When the product is totally soluble in an alkaline solution, it is ready for bleaching.—Revue Scientifique.

**The Department** of State publishes the following from Consul Monaghan, dated Chemnitz, May 17, 1897: Berlin and Leipsic are boasting about a new invention, to be known as iron felt. It is made of the very best woolen materials, impregnated with the inventor's patented preparation, which gives it 2,220 pounds' power of resistance to every square centimeter (0·3937 inch). The article is most useful for railroads of all kinds. Placed between rails and sleepers, it deadens sound and prevents shocks. The first experiments with the new material were made by the Berlin City Street Railway, over which 360 trains pass daily. The results surpassed the company's most sanguine expectation. Not only was the noise brought down to a minimum, but the wear and tear was materially diminished. It is to be tried on the new roads in Leipsic. Old buildings, and particularly buildings of stone and iron, suffer most from the shocks and noise of passing trains. Such an insulating material seems to be especially adapted for elevated roads.

**The Philadelphia** Fire Underwriters' Association has decided to grant permission for the use of acetylene gas in liquefied form under pressure for lighting purposes, provided that the pressure of gas on the piping in the building to be assured shall at no time exceed one-quarter pound per square inch, and that the cylinder containing the liquefied gas under pressure and all pressure-reducing and safety devices be located outside of such building, and in a separate building well ventilated to the outer air, but of sufficient strength to protect the apparatus from outside interference and from the weather (especially the sun's rays); and that the supply pipe for the building be provided with a hand valve just inside of the building assured, so that the gas may be entirely shut off from such building. It is also provided that the cylinder containing the liquefied gas under pressure shall be equipped with a safety valve to protect against both excessive pressure and unusual increase of temperature, and that both the pressure-reducing and the safety (mercury) valves shall be provided with vent pipes opening into the outer air; and that no acetylene gas or calcium carbide shall be stored on the premises.—Jour. Franklin Institute.

## SELECTED FORMULÆ.

**For Sunburn, etc.**—

ALKALINE LOTION.

| | |
|---|---|
| Bicarbonate of soda | 2 drachms. |
| Powdered borax | 1 " |
| Compound tincture of lavender | 1½ " |
| Glycerin | 1 ounce. |
| Rosewater | 4 " |

Dissolve the soda and borax in the glycerin and rosewater, and add the tincture. Apply with a small piece of sponge two or three times a day. Then gently dry by dabbing with a soft towel.

QUINCE CREAM.

| | |
|---|---|
| Quince seeds | 2 drachms. |
| Distilled water | 10 ounces. |
| Glycerin | 2 " |
| Alcohol, 94 per cent | 1 " |
| Rosewater | 2 " |

Boil the seeds in the water for ten minutes, then strain off the liquid, and when cold add to it the glycerin, alcohol, and rosewater.

GLYCERIN CREAM.

| | |
|---|---|
| White soft soap | 2½ drachms. |
| Glycerin | 1½ " |
| Almond oil | 11 " |

Well mix the glycerin and soap in a mortar, and very gradually add the oil, stirring constantly until perfectly mixed.

BISMUTH LOTION.

| | |
|---|---|
| Subnitrate of bismuth | 1½ drachms. |
| Powdered French chalk | 30 grains. |
| Glycerin | 2 drachms. |
| Rosewater | 1½ ounces. |

Mix the powders, and rub down carefully with the glycerin; then add the rosewater. Shake the bottle before use.

ALMOND CREAM.

| | |
|---|---|
| Glycerin cream | 2 drachms. |
| Jordan almonds | 4 " |
| Rosewater | 5 ounces. |
| Essential oil of almonds | 3 drops. |

Blanch the almonds, and then dry and beat them up into a perfectly smooth paste; then mix in the glycerin cream and essential oil. Gradually add the rosewater, stirring well after each addition; then strain through muslin.—Bulletin of Pharmacy.

**French Blacking (Jacquard's).**—

| | Parts by weight. |
|---|---|
| Freshly calcined animal charcoal | 750 |
| Muriatic acid | 250 |
| Treacle | 1,000 |
| Prussian blue | 30 |
| Indian lake | 30 |
| Olive oil | 500 |
| Total | 2,560 |

Treat the charcoal with the acid, stir in the finely ground Prussian blue and Indian lake, then the olive oil, and finally the treacle. The olive oil may be replaced by a cheaper one. The blacking made from spent charcoal from sugar refineries goes mouldy.—Oils, Colors and Drysalteries.

**Nail Cosmetics.**—A "nail wash" sometimes used is:

| | |
|---|---|
| Oxalic acid | 30 grains. |
| Rosewater | 1 ounce. |

As a varnish or polish use:

| | |
|---|---|
| Paraffin wax | 60 grains. |
| Chloroform | 2 ounces. |
| Oil rose | 3 drops. |

—Pharmaceutical Era.

**Varnish for Violins, etc.**—

| | |
|---|---|
| Mastic in tears | 10 parts. |
| Dammar, soft white | 5 " |
| Colored turps | 100 " |
| Raw linseed oil | 5 " |

It is made as follows: A layer of ground glass is placed in a wide bottomed flask, then the 100 parts of the colored turps, then the mastic, and tie two left in contact together for several hours, with frequent shaking. The dammar is then added, which takes another twenty-four hours for solution. In winter each period will require to be extended to thirty hours. The oil is then added, and well incorporated with the varnish by frequent shaking. After standing for another fifteen hours in diffused daylight, the whole is filtered through a cotton cloth. The varnish is greatly improved by keeping from six to eight months before use. The red coloring matters are sandalwood deep (Caliatour), dragon's blood, and gamboge for the yellow, mixtures of the three giving any desired tint.—Oils, Colors and Drysalteries.

**Swiss Alpine Milk Shake.**—

| | |
|---|---|
| Mint sirup | 5 pints. |
| Fine Rhine wine | 2 " |
| Messina lemon sirup | ½ " |
| French rose cordial | ½ " |

Mix well together and filter.

For dispensing, put 1½ ounces of this sirup into a tumbler, clean cracked ice half glass, fresh milk enough to fill glass; then shake thoroughly and top off with a piece of mint.

**Stove Polish.**—The following formula has been used with very satisfactory results by some of our readers: Melt 400 grammes of asphalt on the open fire, allow to cool, break up and dissolve in sufficient oil of turpentine to bring the whole up to 1.000 grammes.

**Moth Paper.**—

I.

| | |
|---|---|
| Carbolic acid | 1 ounce. |
| Ceresin | 1 " |
| Naphthalin | 2 " |

Melt, immerse pieces of bibulous paper, and dry these on plates.

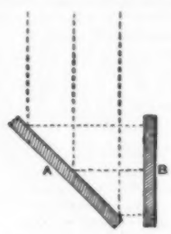
II.

| | |
|---|---|
| Carbolic acid | 1 ounce. |
| Camphor | 1 " |
| Benzin | to make 1 pint. |

Saturate pieces of blotting paper, and apply, or use the liquid in the form of spray by means of an atomizer.—American Druggist.

## ULTIMATE OPTICAL EFFICIENCY.

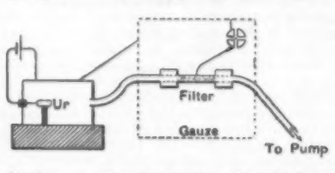
SOME years ago Rayleigh discussed the relative limiting accuracy of the two methods then commonly in use for observing small angular deflections of a suspended system, i. e., the Gaussian method of scale and mirror and the method of the pointer and microscope. The conclusion was reached that theoretically the two systems were on a par with each other when the length of the pointer was equal to the diameter of the mirror. This would give an advantage to the pointer, since that may easily be made ten times as long as the mirror, but in practice this advantage is not maintained. A third method is that based on the interferometer principle, as suggested by Barus and Wadsworth. The latter is of opinion that the smallest movement that can be measured with certainty by this means is that corresponding to a shift of one-twentieth of a fringe. This reduces the estimate of Michelson, who showed that, theoretically, this method of angular measurement may be made from twenty to fifty times as accu-




rate as either of the others referred to. What interferes with the efficiency of the new method is the unsteadiness of the mirrors whose motion lengthens and shortens the path of the interfering beam. Besides, the necessity of two mirrors increases the moment of inertia of the suspended system, and in some cases actually gives the older methods the advantage. Of the two latter, the German method of scale and telescope has the advantage over the English "spot" method, chiefly because of the greater fineness of the reference line (a cross wire in the telescope). A simple way of doubling the efficiency of either method is illustrated in the diagram. The beam is reflected by the movable mirror, A, on to a stationary mirror, B, placed close to it. The latter reflects the beam nearly in the same path, but any angular motion of the mirror, A, produces a motion of four times the amplitude after three reflections. In order to realize the full effect of the aperture of the mirror the two mirrors should be more nearly parallel than shown, and should be as close together as possible.—Wadsworth, Phil. Mag., July, p. 83.

## ELECTRIFICATION BY URANIUM.

J. C. BEATTIE has investigated the electrification of air by metallic uranium and its compounds by means of the electric filter method. The filter used was a block tin tube ten centimeters long and one centimeter wide, filled with brass filings. This was insulated on two tunneled pieces of paraffin, and put in metallic connection with the insulated pair of quadrants of a quadrant electrometer of one ten-thousandth microfarad capacity. From one of the pieces of paraffin a metal tube led to an air pump, from the other a piece of India rubber tubing led to the place where the air to be tested was. This air was then drawn through the electric filter, and the deviation of the electrometer reading was noted. The latter showed 0·7 volt as the electrification of the filter by air drawn from the neighborhood of the positive electrode of a Ruhmkorff coil when the terminals were too far apart to allow a spark to pass after one minute of pumping. To examine the electric state of the air in the neighborhood of metallic uranium charged to a given potential, the following experimental arrangement was made: A me-




tallic cylinder was closed at both ends, which were perforated. Air was admitted through one opening, which was plugged with cotton wool, while the other led to the filter. In the cylinder the piece of uranium was placed on a stick of paraffin. No electrification of the air was produced by substituting a piece of lead and charging it up to 95 volts. When the uranium and the copper cylinder were both connected with the sheaths of the electrometer, a deviation of 0·05 volt per minute of pumping was produced. When the uranium was joined to one terminal of a battery, while the cylinder was joined to the other terminal and to the sheath, the electrometer deviation was from + 0·36 to −0·40 volt per minute, when the charge of the uranium was varied between + 93 and −93 volts. Experiments with zinc, aluminum and lead cylinders showed that the nature of the metal did not influence the result. Wrapping the uranium in aluminum foil diminished the electrification, and surrounding it with paraffin wrapped in aluminum stopped it altogether. Similar, though much smaller, electrifications were obtained with uranium acetate and nitrate.—Beattie, Phil. Mag., July, p. 102.

**A peculiar** method for making castings which are to be partly of hard and partly of soft steel is described in Stahl und Eisen. If a carriage wheel is to be cast with a hard rim, the form is rotated and hard steel poured in. The centrifugal force sends it round the outer edge, so that it forms a rim, and when it is somewhat cooled, the soft steel is added. By this process a very intimate union is obtained, and the wheel is provided with a hard steel rim. The transition from one grade of steel to the other is not gradual, but is sudden.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## TABLE OF CONTENTS.


PAGE

I. AGRICULTURE.—Preservation of Fresh Grapes and Seed Potatoes in Italy..... 18083

II. ARCHÆOLOGY.—Address by Sir JOHN EVANS.—An Important Archæological Resume, with a Portrait of Sir John Evans.—1 illustration..... 18081

III. ARCHITECTURE.—The New Russian Church at Karlsbad, Bohemia.—1 illustration..... 18079

IV. BIOGRAPHY.—Edward Drinker Cope, Naturalist.—The third installment of the presidential address of Prof. GILL before the A. A. A. S..... 18080

V. BOTANY AND HORTICULTURE.—Alpinia Nutans.—1 illustration..... 18081

VI. ELECTRICITY.—Sectorless Wimshurst Machines.—By S. M. KEENAN.—A valuable article for amateurs who are interested in static electricity.—4 illustrations..... 18072
Electrification by Uranium.—1 illustration..... 18085
The Trial of the Marconi Telegraph at Spezia.—A most interesting account of the experiments that Signor Marconi conducted at Spezia, with a view taken from a photograph showing Marconi's work.—2 illustrations..... 18071

VII. FUELS.—Moisture in Coal..... 18074

VIII. MECHANICAL ENGINEERING.—Cold Saw for Crank Webs.—1 illustration..... 18075

IX. METALLURGY.—Aluminum in Knitting Machinery.—By GEORGE D. RICE.—An important article on making and finishing small aluminum castings.—7 illustrations..... 18075
A Rapid Method for the Determination of Silicon in Silico-Spiegel and Ferro-Silicon..... 18075

X. MISCELLANEOUS.
Electrical Notes..... 18086
Miscellaneous Notes..... 18086
Selected Formulæ..... 18086

XI. OPTICS.—Ultimate Optical Efficiency.—1 illustration..... 18086

XII. PERPETUAL MOTION.—Perpetual Motion, II.—The second installment of this interesting and important series.—6 illustrations..... 18076

XIII. PHOTOGRAPHY.—Underground Photography.—This article is illustrated with flashlight photographs in mines and is accompanied by illustrations of the apparatus used.—4 illustrations..... 18074

XIV. SCIENCE.—The Science of Humanity.—By W. J. MCGEE.—Of the science of animal man.—The second installment of this address, treating of the science of animal man, the activities of man, etc..... 18083

XV. SUBMARINE EXPLORATIONS.—Description of a Closing Tow Net, for Submarine Use at all Depths.—By C. H. TOWNSEND.—A full description of an ingenious device for submarine exploration.—6 illustrations..... 18073

XVI. TECHNOLOGY.—Acidproof Cement..... 18084

XVII. TRAVEL AND EXPLORATION.—The Stockholm Exhibition.—2 illustrations..... 18078
The Subsistence Question in the Klondike Region.—A very important article by an authority, giving information of interest to all who think of going to the new gold regions.—The statistics are very complete..... 18079



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